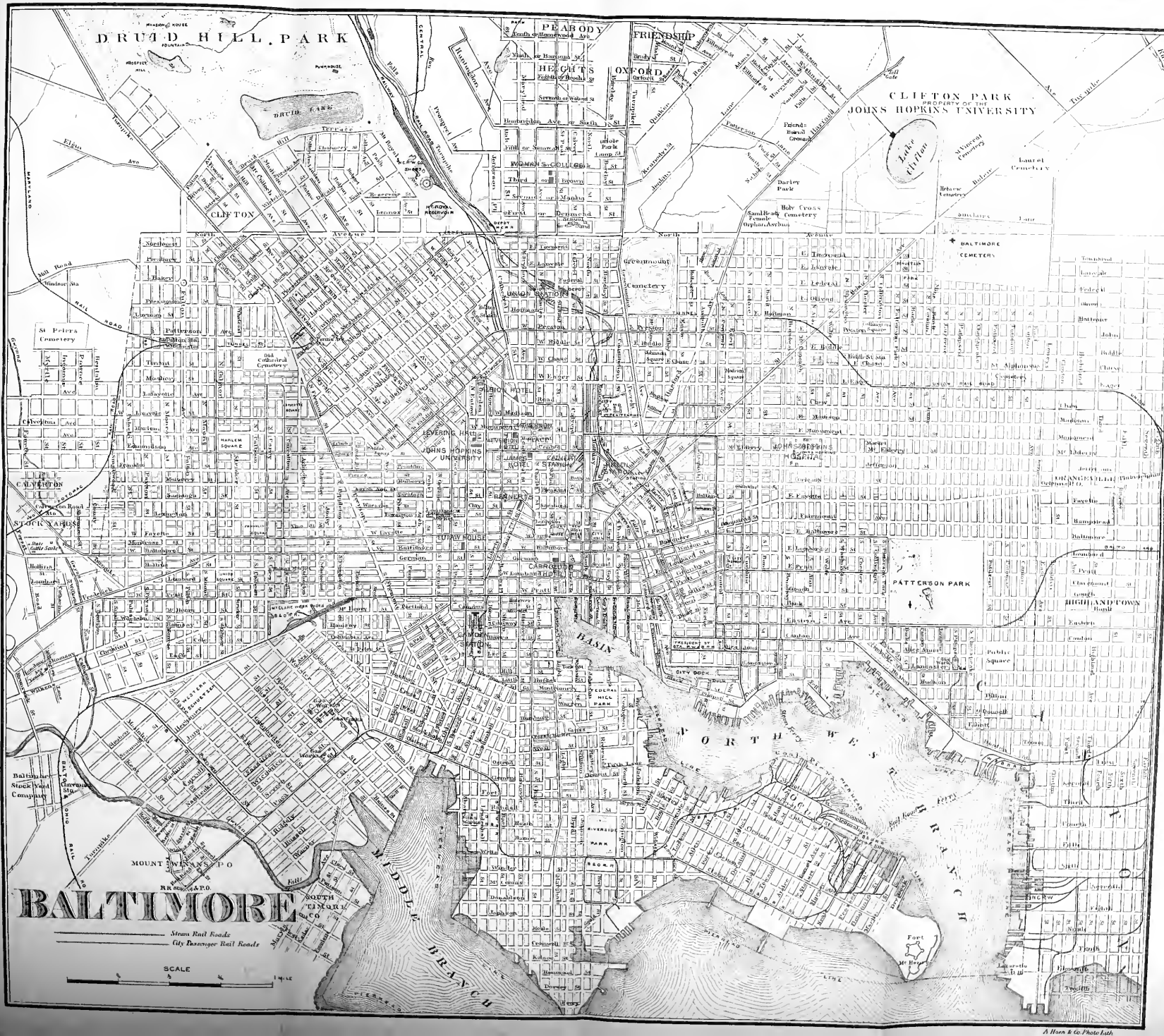
BALTIMORE

American Institute of Mining Engineers

FEBRUARY, 1892


DRUID HILL PARK
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PROPERTY OF THE JOHNS HOPKINS UNIVERSITY
CLIFTON
BALTIMORE CEMETERY
Greenmount Cemetery
Laurel Cemetery
Holy Cross Female Orphan Asylum
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UNION STATION
UNION HOTEL
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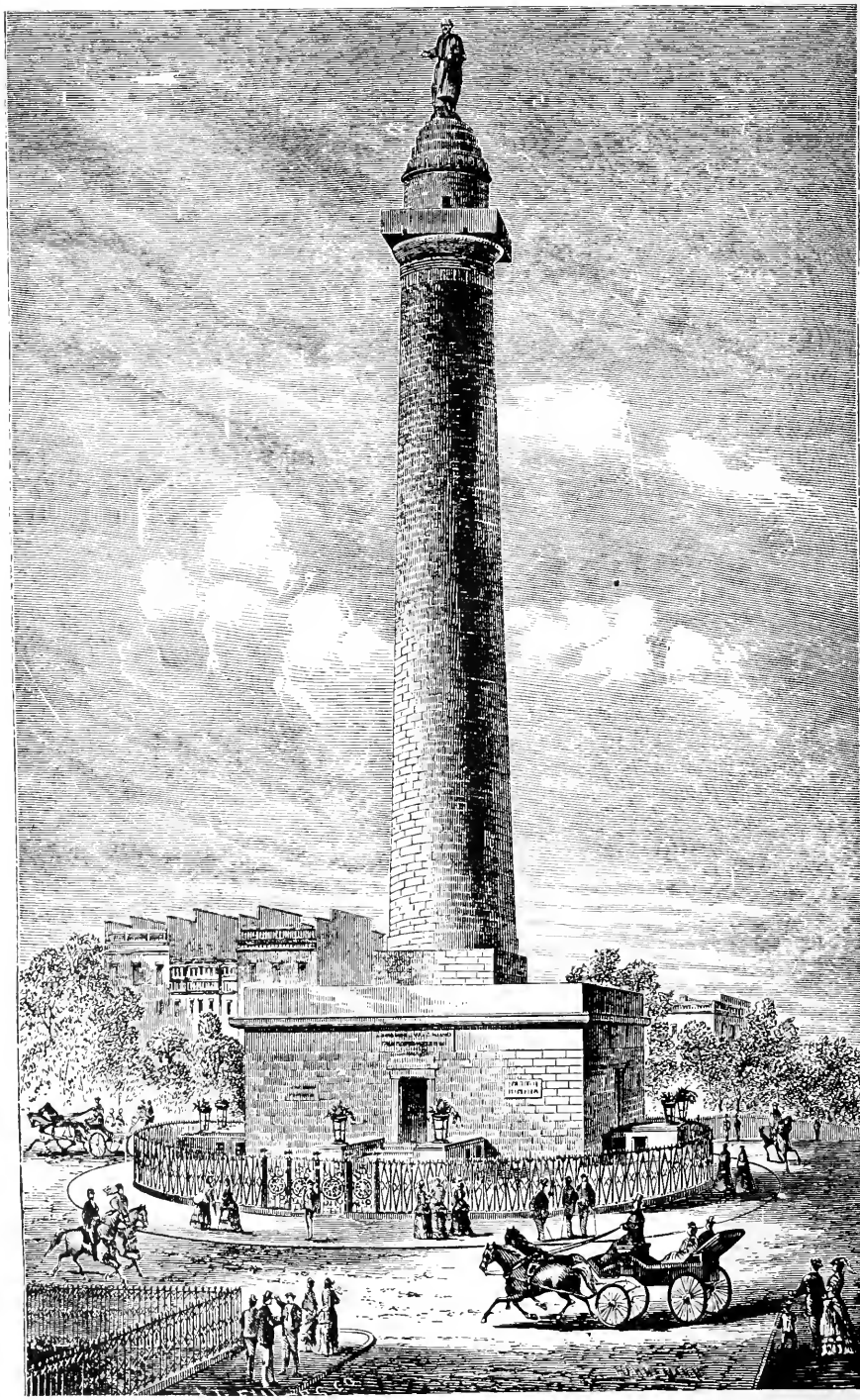

Washington Monument, Mt. Vernon Place, Baltimore.

Williams, George Huntington, ed.

GUIDE

TO

BALTIMORE

WITH AN

ACCOUNT OF THE GEOLOGY OF ITS ENVIRONS

AND THREE MAPS

AMERICAN INSTITUTE

OF

MINING ENGINEERS

BALTIMORE MEETING

February, 1892.

PREPARED BY THE LOCAL COMMITTEE FOR THE USE
OF THE INSTITUTE

G.J

JOHN MURPHY & CO., PRINTERS,
BALTIMORE.

PREFATORY NOTE.

It has seemed to the Local Committee advisable to prepare for the use of the members of the American Institute of Mining Engineers a guide-book of Baltimore and its environs which shall serve as a suitable souvenir of their visit. Aside from the usual programme, they are therefore offered many details regarding institutions and objects of public interest, as well as of such private enterprises as may particularly attract their attention.

To this matter is added a description of the geology of the surrounding region, both on account of its intrinsic variety and interest and because it affords a key to many of Baltimore's characteristics and industries. The value of this portion of the book is greatly enhanced by the colored geological maps, which have been secured through the aid of the Director of the United States Geological Survey.

Many of the descriptions of the great foundations of Baltimore have been furnished by the gentlemen who stand at their heads. Aside from those whose authorship is recognized in the text, the editor would gratefully acknowledge assistance received from Mr. J. W. Tyson, Mr. J. R. Bland, Mr. N. Murray, Dr. W. B. Clark, Mr. H. S. Gane, and Mr. M. J. Vea.

GEORGE H. WILLIAMS.

JOHNS HOPKINS UNIVERSITY,
Feb. 8th, 1892.

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AMERICAN INSTITUTE OF MINING ENGINEERS.

PROVISIONAL PROGRAMME.

Tuesday Evening.—Opening Session. Addresses of Welcome by the Chairman of the Local Committee, the Mayor of Baltimore, and the President of Johns Hopkins University. Also, paper by Mr. George F. Kunz, New York City, on the Mining of Gems and other Minerals in Hungary, Bohemia and Russia, which will be illustrated with lantern views.

Wednesday.—Walters' Gallery. Sessions—Morning, Afternoon and Evening, for the reading and discussion of papers.

Thursday.—Excursion to Annapolis, visit to State House, U. S. Naval Academy, and Reception by the Governor of Maryland. In the evening a Subscription Dinner at the Hotel Rennert. The price of tickets has been fixed at $6.00 each for gentlemen and $4.00 for ladies.

Friday.—Excursion to various points of interest on the Harbor, including Sparrow's Point Steel Works, Monumental Chemical Works, Rasin Fertilizing Works, Oil Refineries, Baltimore Copper Smelting Works, Chesapeake Pottery and the Columbian Iron Works, where two U. S. cruisers are now building.

Friday Evening.—A concluding session, if the business of the meeting should require it.

Saturday.—Short excursions to the Belt Line Tunnel and other points of interest.

The following papers have been announced:

The Mining of Gems and other Minerals in Hungary, Bohemia and Russia, by George F. Kunz.

Southern Phosphates Deposits, by GEORGE H. ELDRIDGE, Washington, D. C.

Phosphate Chemistry as it Concerns the Miner, by Dr. T. M. CHATARD, Washington, D. C.

Experiments with the Roessler Converter at the Marsec Refinery, Park City, by C. A. STETEFELDT, San Francisco, Cal.

The Control of Silicon in Pig Iron, by WM. H. MORRIS, Pottstown, Pa.

The Great Gossan Lead of Virginia, by EDGAR C. MOXHAM, of Pulaski, Va.

The Simultaneous production of Ammonia, Tar and Heating Gas, by ALPHONSE HENNIN, Springfield, Ill.

Eastern and Kentucky Coals and Cokes, by JOSEPH H. ALLEN, Pineville, Ky.

La Gardette: The History of a French Gold Mine, by T. A. RICKARD, Allemont, Isere, France.

Granulating Magnetic Iron Ore with the Sturtevant Mill, at the Croton Magnetic Mine, by W. H. HOFFMAN, Brewster, N. Y.

High Pressure Hydraulic Presses in Iron Works, by R. M. DEALEN, Dusseldorf, Germany.

Notes on the Selection of Iron Ores, Limestones and Fuels for the Blast Furnace, by FRED. W. GORDAN, Philadelphia, Pa.

The Iron ores of Ashe County, N. C., by H. B. C. NITZE, Chapel Hill, N. C.

Zinc Mines and Mining near Webb City, Mo., by CARL HENRICH, Ducktown, Tenn.

The Protection of Hearth and Bosh Walls of the Blast Furnace, by JAMES GAYLEY, Braddocks, Pa.

The Rock Drill Applied to the opening of Blast Furnace Holes, by DAVID BAKER, Sparrow's Point, Md.

A New Method for removing Skulls from Direct Metal Ladles, by DAVID BAKER, Sparrow's Point, Md.

Notes on the Geological Origin of Phosphate of Lime in the United States and Canada, by WALTER D. M. DAVIDSON, New York City.

Ancient Method of Silver Lead Smelting in Peru, by OTTO F. PFORDTE, Jersey City, N. J.

There will be a special discussion of the subject of phosphates at such time during the sessions of Wednesday as may be found most

convenient to the participants; and discussion is also invited on the subjects of tests and Requirements of Structural Wrought Iron and Steel, and on any other topics suggested by the papers of this or the preceding meeting. Timely notice is requested by the undersigned of proposed contributions to such discussions, in order that time may be set apart for them.

SKETCH OF THE CITY OF BALTIMORE.[1]

The historic beginnings of Baltimore lack the traditional haze of obscurity associated with the foundation of great cities. The proprietary government of Maryland emerged from the era of troublous times, and entered upon the path of future growth and development towards the close of the first quarter of the eighteenth century. Commerce expanded, population increased and settlements rapidly extended to the northward. It was not long before the need of a port near the head of the Chesapeake Bay began to be felt, and attention to be directed to a remarkable site on the north side of the Patapsco River, offering easy access and safe harbor to vessels of large size, at a distance of but fourteen miles from the waters of the Bay. On the 14th of July, 1729, a petition signed by the leading men of Baltimore County was presented in the Provincial Assembly, praying for the erection of a town at this point. Three weeks later, a bill to the same effect was passed and the history of Baltimore City had begun.

The early life of the settlement was a race for supremacy in trade with older towns of the province—Joppa, the county seat, Elkridge Landing, and Annapolis.

[1] By Mr. J. H. Hollander.

But it is pre-eminently in the struggle for commercial existence that the fittest survives, and Baltimore, with a magnificent harbor, numerous mill streams and rich iron deposits, soon forged ahead of the river points with their rude landings, and less opportunity for developing and being developed by the Bay trade. The issue of the contest was foregone. It reached its culmination in 1768, when the privileges and dignities of County Town, a court-house and a prison, were transferred from Joppa to Baltimore.

The outbreak of the Revolutionary War cut off foreign supplies and stimulated local manufactures and shipping. It indirectly prepared the way for a period of remarkable commercial activity and prosperity, following the final suspension of hostilities in 1783. Continental wars and colonial revolutions increased the European demand for American staples. Export trade in the products of Maryland, tobacco, flour, wheat, and corn, was diverted from the hands of British and Dutch agents and concentrated in Baltimore. Local merchants soon began to engage in carrying trade, and "Baltimore clippers" became famous throughout the world. For many years these "skimmers of the sea," able to sail within four and a half points of the wind, were the fleetest craft upon the seas. More than any other single cause, they contributed to the early commercial development of Baltimore.

Henceforth the history of Baltimore is a story of steady growth and development, interrupted only by great episodes in our national life. Daring blockade running and indirect shipments enabled her merchants to retain possession of a large portion of foreign commerce even dur-

ing the War of 1812. The city was attacked by land and water, but in each case successfully defended. During the latter assault, a patriotic Marylander, while detained on board a British vessel, composed our national anthem, "The Star Spangled Banner."

Baltimore was the natural market for the agricultural products of the interior and Western country. Active communication had long been maintained with this vast region; in early days by pack horses, later by long wagon trains that traversed the great Northern turnpikes as far as the Ohio River. The introduction of steamboats upon the navigable waters of the West displaced this means of transportation. Trade was diverted to other centres, and the commercial relations of Baltimore threatened. Public-spirited citizens immediately began an agitation for improved means of communication with the West. In February, 1827, the first railroad charter granted in the United States was given by the General Assembly to the Baltimore and Ohio Railroad. The work of actual construction was begun in the following year; in 1853 the road was completed to the Ohio River, and in 1857 to St. Louis. This great iron link is an organic part of the life history of Baltimore. It opened up a vast undeveloped region and secured for the city the full advantages, suggested by its natural location, of a seaboard market and distributing depot for the West.

Both trade and manufactures suffered keenly from the events of the Civil War. Maryland was a border State and experienced all the evils of an exposed frontier and constant military occupation. Communication with the South was completely cut off and Western trade tem-

porarily diverted to other channels. But the causes of prosperity were suspended, not destroyed, and as the prostrate industrial life of the country revived, Baltimore fairly bounded into commercial importance. The vigor and activity of those early days has never waned. Subsequent progress has been steady but absolute. It is for this reason that Baltimore now offers more real advantages for trade, commerce, and industry, than any other city on the Atlantic seaboard.

Aside from material inducements, Baltimore is pre-eminently a pleasant place to live in. Its climate is temperate and bracing, removed alike from the bitter cold and enervating heat of more extreme latitudes. The peculiar topographical arrangement of the region facilitates an admirable system of drainage and renders the city as healthful as picturesque. Municipal improvements have kept pace with advancing civilization. Just as Baltimore was the first city in the United States to be illuminated by gas, the first to aid the construction of a railroad, and the first to be connected with the outside world by electric telegraph, so now its water supply is unequalled in magnitude and purity, its parks and squares far-famed for natural beauty, and its police and fire departments of rare completeness and efficiency. Much has been written of the warmth of Baltimore social life. The elements that constitute it evade analysis; but there is everywhere felt a characteristic spirit of heartiness and fellowship, that raises Maryland hospitality to the same pre-eminence as the beauty of its women and the excellence of its bay products.

Baltimore ranks as one of the foremost educational centres of the country. A graded system of public schools provides free instruction in primary, secondary, collegiate, and normal studies. The first manual training school to be maintained as part of a public school system was established in this city. Flourishing colleges of law, medicine, and dentistry, private schools and female institutes attract hundreds of students from every State of the Union. The Woman's College promises to become to the South, what Vassar, Smith, and Wellesley Colleges are to the North. Personal philanthropy in the forms of the Peabody Institute and the Johns Hopkins University has made Baltimore almost unique among modern cities. The experience of the latter institution forms a remarkable chapter in the history of American higher education. Almost within the period which similar foundations have devoted to mere tentative efforts, Johns Hopkins has attained the front rank among higher institutions of learning. Means of positive instruction are supplemented by public libraries, accessible lecture courses and choice art collections. Academic currents penetrate every stratum of Baltimore society and exercise wide and far-reaching influence upon its intellectual life.

The prosperity of Baltimore is but an earnest of future development. Geographical position and railroad connection give it special advantages as an outlet for Southern and Western products. Interior situation, lessening the cost of coal and inland transportation, make it a favorable port of entry for foreign imports. Cheap living, low rents, skilled labor, exemption of plants from taxation

invite manufacturing industries of all kinds. Finally the adjacent coal fields, iron beds, marble quarries of the State, the inexhaustible riches of the Chesapeake unfold a vista of wealth and prosperity, before which even sober historical thought is tempted to become prophetic.

PUBLIC INSTITUTIONS OF BALTIMORE.

PARKS.

Druid Hill Park.—This park, containing an area of 693 acres, is the pride of the city of Baltimore. By many people both at home and abroad, it has been pronounced the finest public park in the world. It was purchased from the Rogers family by the city, in 1860, for the sum of $500,000. Its former owners having laid it out over a hundred years ago in the style of the English parks, had taken great care of the estate and diligently preserved the many and ancient trees with which nature had adorned it.

Since the city has come into possession of the property, its great natural beauty has been heightened by everything that the art of the landscape gardener could suggest.

Its numerous lakes have been stocked with carp and gold fish, and about 200 deer, and several flocks of sheep roam at large throughout the place.

The entrances on North Avenue at Oliver Street, and on Madison Avenue, are both adorned with gateways, and the Mount Royal Avenue entrance is marked by a fountain whose jet sends up a stream through a five inch nozzle, 90 to 100 feet high.

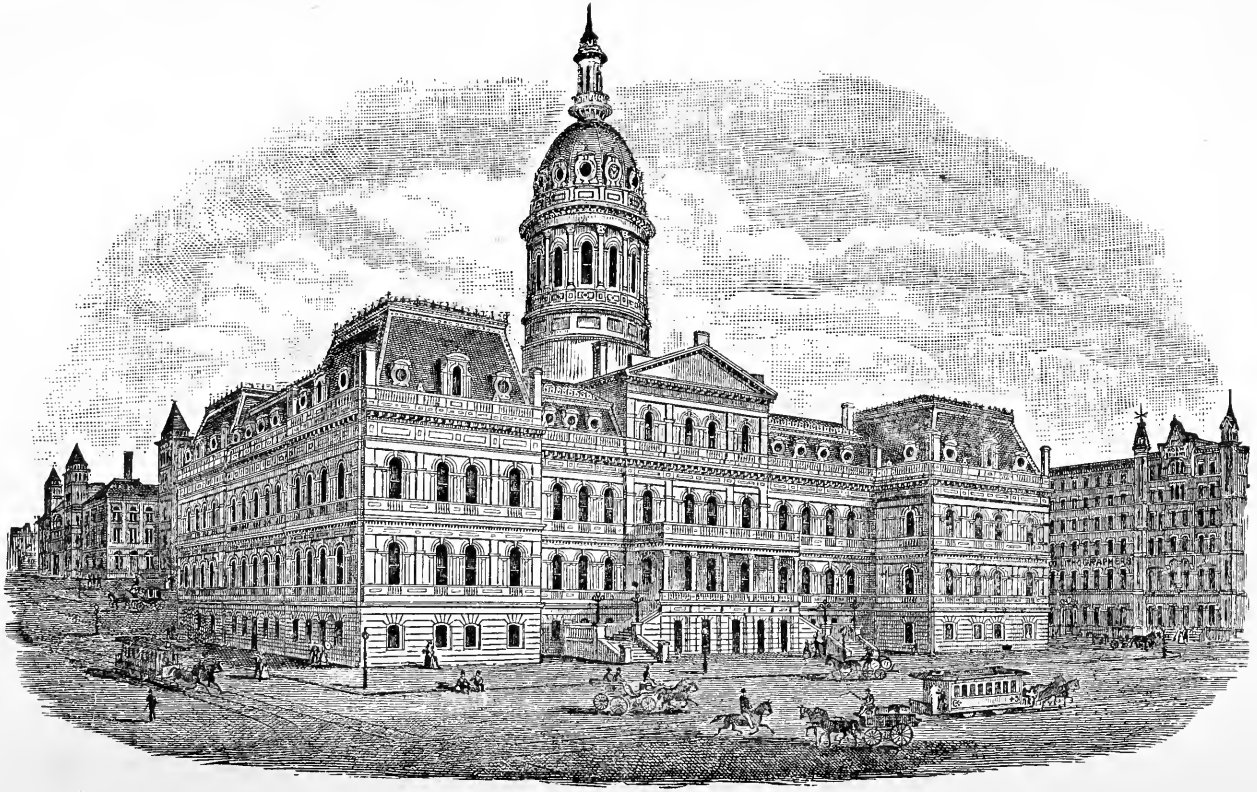
The park is reached by the Cable cars, Madison Avenue and Pennsylvania Avenue street cars, Citizens' Line street cars, Reistertown horse cars, and Northern Central railway from Calvert or Union Depots in the city to Woodberry Station.

Patterson Park.—This is a tract of land containing 113 acres, whose main entrance is on Lombard Street. The place affords a fine view of the harbor and adjacent territory. It is of historical interest as containing the original earthworks thrown up by citizen volunteers in 1814, when fearing an attack on the city by the British. The enemy never reached the place however, being defeated several miles below the city at North Point. The Cable cars and the Citizens' Line street cars connect this Park with Druid Hill Park, five miles distant.

Federal Hill Park.—This park commands one of the best views of the city and harbor to be found in Baltimore. It has been used as the site of the Marine Observatory to signal the approach of shipping. The grounds were purchased by the city in 1878, at a cost of $64,000. The hill is 85 feet above tide, and covers an area of $8\frac{1}{4}$ acres.

Riverside Park.—This is a pleasure resort of $14\frac{1}{4}$ acres in extent. It is of historical note as containing the earthworks known as "Fort Covington," a six gun battery which sunk the barges of the British fleet while attempting to land a night force in the rear of Ft. McHenry in 1814.

Harlem Park.—This plot of ground occupies about two squares. It is located in the West End, between Calhoun and Gilmor streets, and Edmondson and Harlem Ave-



THE CITY HALL, BALTIMORE.

nues. In 1855 the Odd Fellows erected here a monument to Jas. L. Ridgely.

Lafayette Square.—This square is situated between Lanvale street, Carrollton, Arlington, and Lafayette Avenues. The Normal school and five churches face it.

Other Parks.—There are numberless other small parks and squares throughout the city that add to the attractiveness of Baltimore as a place of residence. Among others may be mentioned, Franklin Square, Eutaw Place, Union Square, Madison Square, and Perkins' Spring Square.

CITY HALL AND POST OFFICE.

The City Hall was commenced November 11, 1866, and after nine years in construction, was dedicated on the 25th of October, 1875. The grounds and building cost $2,271,000, the architect being Mr. G. A. Frederick. The building of Renaissance style occupies an entire block, bounded by North, Lexington, Fayette and Holliday streets, and its dimensions are 225 feet long and 140 feet broad. The space covered by the building is 31,500 square feet.

The structure is four stories high with mansard roofs. The centre wing is surmounted by an iron dome 260 feet from the ground, and 170 feet in circumference. A balcony 250 feet from the street affords a commanding view of the city. Although a strictly fire proof building, each department is furnished with secure vaults of large dimensions, lined with iron and steel. Each room is well lighted, heated by hot water and ventilated by ducts.

All the departments of the city government find quarters in the building. On the ground floor are the departments of the Water Board, Board of Health, City Commissioners, Inspectors of Buildings and Gas, City Fire and Alarm Telegraph, Port Warden and Board of Police.

On the second or principal floor are the offices of the Mayor, City Register, Comptroller, Collector, Appeal Tax Court, School Board, Street Commissioners and Park Commissioners.

The third floor is occupied by the Chambers of both Branches of the City Council; the grand Public Hall, City Library, Law offices, Water Board, City Surveyors and Engineers. There is an entrance on each side of the building. The main one on Holliday Street, facing the east, is marked by a handsome marble portico with doors of bronze.

The Post Office is a large and commodious building, situated in the heart of the business part of the city. It occupies a square of ground between the Battle Monument and the City Hall. The site cost $500,000, and the total cost, including site and building, was over a million dollars. The structure is in the style of the Renaissance, being very high and broad, and accommodates not only the mail service but also furnishes rooms for other departments of the National Government.

FORT McHENRY.

This fort, owing to the part it played in the war of 1812, has a national historical interest. In 1814 the British, in an attempt to capture the city of Baltimore,

landed an army at North Point, and then advanced to bombard the fort. Both the land and naval forces, however, were repulsed, and it was during the bombardment that the national anthem, "The Star Spangled Banner," was written by Francis S. Key, who was a prisoner on one of the British ships during the engagement. The fort was constructed of brick in the form of a star about the year 1792, but it has since been considerably enlarged and strengthened, and is now surrounded by spacious grounds.

At present companies D, G and I, of the 3rd Artillery U. S. A., are stationed there under the command of Col. Bainbridge. This force numbers twelve officers and about 180 men. The fort can be easily reached by taking the Druid Hill cars to Locust Point.

BATTLE MONUMENT.

This Monument was erected by the city to the memory of those citizens of Baltimore, who fell on the 12th and 13th of September, 1814, at the battle of North Point and bombardment of Fort McHenry. It stands in Monument Square, on the site of the first court house, built in 1769, and demolished early in this century. It is centrally located, being directly in front of the Post Office and near the present Court House.

The Monument without the statue is 42 feet 8 inches high, the statue 9 feet 6 inches—total height 52 feet 2 inches above the platform. M. Godfroy was architect, and Antonio Capeleno, sculptor. The design of the structure is intended to be allegorical. The shaft of the monument

presents a fasces, symbolical of the Union. This is ornamented at the bottom on the north and south fronts with bas-reliefs, one representing the battle of North Point and death of General Ross; the other, the bombardment of Fort McHenry. Lachrymal urns indicate the purpose of the monument, and the names of those who fell in battle are inscribed on the entablature. The whole is surmounted by a statue, representing the city of Baltimore. The corner-stone of the structure was laid September 12th, 1815.

MOUNT VERNON PLACE.

Mount Vernon Place is one of the best sites in Baltimore for a stranger to visit, as its whole tone is typical of the city. Its monument, fountains, statues, roadways, public and private buildings, have all an air about them of characteristic solidity and quiet beauty.

Its most striking object is the Washington Monument, of white marble, erected by the State of Maryland to the memory of the "Father of His Country." The base of the monument is 60 feet square and 35 feet high, from which a doric column (average diameter 18 feet) rises to a height of 165 feet above ground. Upon the capital of the column is a gallery and above that a statue of George Washington, 15 feet high. It represents him in the act of resigning his commission as General-in-Chief of the United States armies. The figure was executed by Gregory, and is pronounced a work of great merit. The architect of the whole structure was Mr. Robert Mills. The base of the monument is 100 feet above tide, its top 280 feet. In the inside a spiral staircase of 220 steps

ascends to where a most superb view of the city is presented.

The corner stone was laid July 4, 1815, and the statue raised into position October 19, 1830, about fifteen years having elapsed in the construction of the whole work.

From the four sides of the monument grass-plats radiate north, east, south and west. These are adorned with flowers, fountains and statuary, of the last named the most noticeable are several bronze pieces by Barye, representing Peace, War, Force and Order, and a colossal lion; also "Military Courage" by Dubois.

The Peabody Institute, Methodist Episcopal Church, and numerous private dwellings surround the place. Of the private houses that of Mr. Walters, whose collection of paintings and curios is world-renowned, is of most interest to visitors.

In the near vicinity of Mount Vernon Place are two large hotels and several of Baltimore's most famous clubs.

WALTERS' GALLERY.

This is in the private house of Mr. William T. Walters, 5 W. Mount Vernon Place. Mr. Walters began life as an engineer, but early turned his attention to the collecting of works of art, in which he has been ably assisted by his son in late years. He is now, as all know who are acquainted with the subject, an authority on Japanese and Oriental art. His collection in this line is the largest, most complete, and most carefully selected private collection in this country. His galleries are open to the public at a nominal fee, devoted to a local charity, every

Wednesday in February and March, and Wednesdays and Saturdays in April. Also on February 22nd and Easter Monday.

The two following extracts, published eight years since, will serve to indicate a few of the treasures to be found upon a visit to Mr. Walters' house.

[*Extract from the New York Sun (editorial), February 27th, 1884.*]

* * * * * * * * *

Mr. Walters reverses the principle of nothing for art and everything for show. There is no other collection of pictures in America that equals in importance and interest his collection. There are great public galleries in Europe that far overshadow it, especially in their display of the works of the middle-age masters; but there is no collection, public or private, in Europe that equals it in its high standard of excellence or in the variety of the schools represented, nor are there anywhere galleries so handsome, so agreeable in proportion, or so fitting in adaptation to use and in beauty of decoration. The pictures themselves are a complete index to the best art of this century. Nothing is missing, and every example is of the best manner of the master it represents. There can be no higher purpose in forming a collection than is herein implied, and it has been maintained steadily from the beginning.

There are four galleries in all, and while the two which contain the paintings are of the importance described, the collection of Oriental art arranged in the others is the most valuable in existence. There are between four and five thousand examples, ranging from the finest porcelains

of the best epochs of the art of the Chinese ceramist down to Inros and Netsukes, the exquisite trivialities of the consummate artists of Japan. The field which it covers is a wide one, and the museums of Europe do not approach it in interest. There is nothing like it anywhere, and to the student of ceramic art and of the marvellous workmanship of the Chinese and Japanese in the precious and other metals it affords an opportunity for research and enlightenment that he will not find anywhere else. It has the proportions of a museum, but it is one in which only objects of the rarest beauty are preserved.

[*Extract from the New York Tribune, February 27th, 1884.*]

* * * * * * * * *

Mr. Walters' finely chosen collection of paintings, choice as it is, can hardly be termed unique in this country. But there is nothing in America to be compared with his departments of Oriental art.

No hint of this is afforded by the exterior of the plain, old-fashioned house under the shadow of the Washington monument. Spacious and substantial, it has the air of permanence peculiar to the houses of Mount Vernon Place, and nothing more. The large parlors contain bronzes, cases of rare old silver, and groups of Royal Worcester, Dresden and Sevres, which elsewhere would be counted noteworthy. There is a dainty chamber fitted up in blue, with furniture and wall-hangings of the time of Marie Antoinette. There is another furnished in the old Dutch style, with a richly-carved cabinet, a delightful writing desk, with brass mountings. Another upper room contains bronzes and water colors by Barye, who

was among French artists in bronze what Rosa Bonheur is among painters. Rare French vases and bronzes catch the eye in the panelled dining room.

The first gallery at the rear of the house is lined and nearly filled with cases of porcelains. On the walls hang tapestries with colors as soft and beautiful as those of the Persian rugs upon the floor. In the centre, upon a stand of teak wood and brass, is a bronze some eight feet high, with dragons writhing up its sides toward the figure of a daimio on top. The slight ebony framework of these great cases presents no interference with the splendid effect of the porcelains within. Here are vases fashioned under the famous Ming dynasty, 1368–1649; others of the early eighteenth century, showing in their decorations the effect of European influences; here is a stately array of blue and white ware, with the so-called hawthorn, really plum-blossom, decoration, and near by is a little vase, perhaps rarest of all to connoisseurs, with white panels relieved by black, upon which the hawthorn pattern reappears. I have no time now to dwell upon the solid colors, the bullock's blood, Chinese white, turquoise, mustard yellow, sage green and tea color, or upon the one hundred and fifty examples of egg-shell porcelain. There are 1,400 specimens of the Chinese ceramic art, each selected by Mr. Walters or by his son, who inherits his cultivated tastes and fine judgment, for it is worth while to bear in mind that this is not a dealer's collection, but every object is the result of the ripe experience of the collector.

Japanese as well as Chinese art finds a place in this gallery. There is a case of genuine Satsuma, whose

creamy yellow and pale chocolate hues and delicate crackle are known to most people only through imitations. There are 400 Japanese porcelains and potteries, and the whole ceramic display illustrates the history of the art for over 800 years. Nothing now can be said of the drawers filled with Chinese flaçons and Japanese sword guards, pipes and 150 swords, "the jewelry of Japan."

In a covered bridge extending over an alley from this first room to the picture gallery are scores of bronzes, including several by Saymin and Gorosa, among which is a little group of the most exquisite porcelains in the collection, examples of the bullock's blood, peach-blow and coral splashes. In the picture gallery are four large cases containing royal lacquers, and rows of drawers filled with Netsukes, ivory carvings and Inros.

Let me sum up the Oriental department. There are 200 bronzes, 200 metal objects of gold, silver, iron and copper; 150 swords, 300 sword guards and 400 other appliances of the sword, 500 ivory carvings and 500 lacquers, illustrating the history of lacquer-work for over 700 years. With the porcelains and a few miscellaneous pieces, the Oriental department contains 4,100 objects, chosen, in the language of the collector, "to secure characteristic examples of the beautiful, rather than of the merely curious."

The 150 oil paintings represent a similarly intelligent and catholic process of selection. The collector, I judge, has had it in mind to illustrate the art history of the century by examples of men whose influence has been most strongly felt. In French art expressions of the

religious sentiment of Ary Scheffer and the fiery spirit of Horace Vernet are followed by examples of Delacroix and Delaroche, and these by examples of Jalabert and Yvon; four works by Gérome, including the "Diogenes" and "Christian Martyrs;" five by Millet, four by Rousseau, three by Corot, three by Fromentin, four by Daubigny, three by Dupré and a Troyon.

One group of four landscapes, which include Rousseau's magnificent "Winter Solitude," is the artistic center of the collection. Couture, Decamps, Gleyre, Isabey, Saint Jean, Plassan, with Meissonier, Herbert, Schreyer, De Neuville, Detaille, Jacque, Van Marcke and Ziem—these names may serve to indicate the extent to which French art is represented.

Fortuny, Jiminez and Rico illustrate the Franco-Spanish school; Baron Leys' "Edict of Charles V," speaks for modern Belgian art; the Achenbachs, Preyer, Vautier and Hiddemann represent Dusseldorf; Gallait and Clays, Brussels; Professor Muller, Vienna; Carl Becker and Knaus, Berlin; Millais, Alma Tadema and Boughton, England; and America is represented by Gilbert Stuart, A. B. Durand, C. L. Elliott, George A. Baker, F. E. Church, Eastman Johnson and H. Bolton Jones. Necessarily in so small a collection the representation is little more than an incomplete expression of the collector's purpose. Among other pictures Millet's original design in black and white for the "Angelus" easily stands first in point of interest.

The water color room opening from the first gallery contains water colors by Alma Tadema, Green, Fortuny, Meissonier, a drawing in india ink by Rousseau, and

another in ink and pastel, together with statues by Rinehart and Palmer.

THE PEABODY INSTITUTE.[1]

This great foundation was endowed by George Peabody, an American banker, who at that time resided in London, but who had made the first part of his great fortune in Baltimore between the years 1815 and 1836. A strong friendship for the people of this city led him to determine that he would found an institution which should advance the intellectual and moral culture of the whole community. In the year 1854, after consultation with friends in Baltimore, as to the kind of institution which might best fulfil his purposes, he proceeded to develop the scheme. With the aid of the Hon. John P. Kennedy and one or two other associates, he matured a plan which he embodied in a letter, dated February 12, 1857, to twenty-five gentlemen of this city whom he selected to be trustees to carry his designs into effect. At the same time he placed a fund of $300,000 at their disposal, to be expended in securing a site, erecting a building, and maintaining an educational establishment of the highest order, which should include a Library, a School of Lectures, an Academy of Music, a Gallery of Art and a System of Premiums to the High Schools of the city. These gentlemen accepted the trust in the spirit of the founder, and immediately proceeded to secure a piece of ground for a building. A site was selected on Mount Vernon Place near the Washington

[1] By Professor P. R. Uhler.

Monument, and a massive white marble building, 150 feet long by 75 feet wide, was begun in 1858, and the corner stone laid on the sixteenth of April, 1859. This wing was finished and ready for use in the autumn of 1861.

In the meantime, Mr. Peabody increased his gift to $500,000, and on the occasion of his visit to Baltimore in 1866, he raised the endowment to $1,000,000. To this princely sum, in 1869, he added Virginia and Tennessee bonds, which brought the fund to a total of $1,240,000. This west wing when completed was provided with a Lecture Hall, occupying the entire lower floor, and above it was placed a library apartment, 100 feet long by 40 feet wide, separated by a longitudinal partition from a large reading-room and offices for the public business. Before the building was finished, the Rev. Dr. John G. Morris resigned his place in the Board of Trustees to take the position of Librarian. The functions of this office he exercised with undoubted ability, from 1860 to the summer of 1867, and he also assisted the committees in securing able lecturers and accomplished concert masters.

During the first three years, the collections of books grew less rapidly than later, because of the high rates of exchange and the necessity of importing books from Europe. Only books of scholarly value were to be collected, and much time was spent in preparing printed lists of such as were suitable for a library of reference. From 1861 to the month of May, 1866, about 15,000 volumes had been collected, and their titles, written on cards, were placed in drawers for the free use of all persons who came to read in the library. As an appro-

priation of $100,000 had been made for books and maps, large orders were sent to the three agents in Europe, and great numbers of volumes were shipped to the Institute before the close of the year 1866.

The Library, which had been placed and arranged on the second floor of the west wing, was formally opened to the public on October 25, 1866, in the presence of the Founder. On this occasion, Mr. Peabody received the citizens of Baltimore at the Institute, and listened to an address written by the Hon. John P. Kennedy, but which, in his absence, was delivered by Judge George W. Dobbin. To this Mr. Peabody replied in a sympathetic tone, which deeply impressed the large audience that crowded the hall. The Governor of the State, Hon. Thomas Swann, was also present and spoke in honor of the occasion.

The work of the Institute was now in full operation, the Library was open to the public from 9 until 4 o'clock daily except Sunday; courses of lectures were delivered in the autumn and winter; public concerts of orchestral music were given in the large hall; and premiums of money and gold medals were annually conferred upon the most distinguished graduates of the city high schools.

In the month of June, 1867, the Rev. Dr. Morris withdrew from his position in the Institute, and the Assistant Librarian, Mr. P. R. Uhler, remained in charge of the library until the autumn, when Mr. Nathaniel H. Morison, the newly elected Provost, entered upon his duties as chief executive officer of the Institute. At this time the library had secured more than 22,000 bound volumes, and the written catalogue included about

100,000 cards. Two years later a more complete organization of nearly all departments of the Institute had been developed and plans of management adopted which have mostly continued to the present time.

Mr. Peabody placed the Library first in his scheme of organization, and recognizing this fact the new Provost directed his most earnest attention to the steady increase of the already valuable collection of books, until at the time of his death in November, 1890, the Library contained 100,000 volumes. He also superintended the construction of the catalogue, directed the series of lectures, attended to the general interests of the Conservatory of Music, and regulated the business of the Institute in connection with the Committee controlling the several departments.

In the month of April, 1875, a new wing of the building was begun, and every stage of its construction closely studied and watched by the Provost until its completion in July, 1878. This new division extended the front to a width of nearly 175 feet, and gave place for a Library Hall and work rooms capable of accommodating nearly 500,000 volumes, a reading room with space for seating 100 persons, two large rooms on the second floor to hold statuary, and a basement divided into two fine Lecture Halls, with the accompanying smaller rooms and janitor's apartments.

After the completion of the building, the library, numbering 40,000 volumes, was removed to the new wing, and the old hall was fitted for and occupied by the Gallery of Paintings.

The Institute building is now occupied by a Library of costly learned books, numbering about 110,000 volumes; a Gallery of Art embracing the Garrett, Rinehart and McCoy statuary, and the collection of oil paintings, also left to the Institute by Mr. McCoy. A large part of the west wing, above the lecture hall, is occupied by the Conservatory of Music, where the Director, Mr. Asger Hamerik, assisted by six Professors, conducts the studies of advanced pupils, who after critical examination have been admitted to the privileges of the department of music. In the large hall, lectures and symphony concerts, of the highest grade, are given during the winter season; and in the smaller halls musical recitals and students' concerts are conducted throughout the scholastic term. By a recent decision of the Trustees the Library is kept open during all the fall and winter months from 9 o'clock in the morning until 10.30 at night.

This "University for the People" is now carrying the blessings of the higher education down to the every day life of this community, and touching all the outlying sections of the neighborhood with the benedictions pronounced by Mr. Peabody. By its valuable Library covering every department of human thought; by its lecture courses whose low price of admission places them within the reach of all; and by the splendid culture of its musical instruction and numerous concerts, this Institute is doing the benevolent work prescribed by its Founder.

THE ENOCH PRATT FREE LIBRARY.[1]

This Institution was founded by Enoch Pratt, a native of North Middleborough, Massachusetts, who first became a resident of Baltimore in 1831, entering into business as a commission merchant. Fifty-one years after this, he offered to the Mayor and City Council a proposition to establish a Free Circulating Library for the benefit of the whole city. His plan was to erect, for its accommodation, a fire-proof building capable of holding 200,000 volumes, which would cost about $250,000, together with four branches in different parts of the city, and to give in addition the sum of eight hundred and thirty-three thousand, three hundred and thirty-three and a third dollars, provided the city would grant and create an annuity of fifty thousand dollars per annum forever, payable quarterly to the Board of Trustees, for the support and maintenance of the Library and its branches. The offer and the conditions being accepted, a Board of Trustees named by Mr. Pratt with powers of self-perpetuation was entrusted with the important duty of superintendence. Mr. Pratt, in his letters to his Board, states that the books are

THE ENOCH PRATT FREE LIBRARY.

[1] By Dr. L. H. Steiner.

"for all, rich and poor, without distinction of race or color, who, when properly accredited, can take out the books, if they will handle them carefully and return them."

In November, 1884, the Board selected as the Librarian, Lewis H. Steiner, to whom was entrusted the organization and subsequent superintendence of the Library.

The Central Building is on Mulberry near Cathedral street, with a frontage of eighty-two feet and a depth of one hundred and forty-two feet. The front is of marble, the building being treated in the bold Romanesque style, with characteristic semi-circular forms, relief mouldings, enriched by carvings and embellishments. The Branch Libraries, of which there are five, are located as follows: branch No. 1, corner of Fremont and Pitcher streets; branch No. 2, corner of Hollins and Calhoun streets; branch No. 3, corner of Light and Gittings streets; branch No. 4, corner of Canton and O'Donnell streets; and branch No. 5, corner of Broadway and Miller street. They are built of brick, one story in height, forty by seventy feet, with high, well-lighted, basements. Their capacity is about twenty thousand volumes each. The six library buildings are supplied with reading rooms and stock rooms for the accommodation of books.

On the first of January, 1891, the Central building contained 68,741 volumes, the five branches 37,921—the total being 106,662. The increase during the year was 13,320 volumes.

The circulation for home use during the year 1891, was from the six Libraries 444,028, of which 262,920

were from the Central building, while 129,795 magazines and reviews were called for in the different reading rooms.

The reading room of the Central Library is open to visitors and readers from 9 a. m. to 10 p. m. each week day, and those of the Branches from 2 p. m. to 9 p. m. The Library in its different departments employs fifty persons, twelve males and thirty eight females.

THE UNIVERSITY OF MARYLAND.

The University of Maryland, situated at the corner of Lombard and Greene streets, was founded in 1807 as a medical school. The present building was erected in 1812 after plans by R. Cary Long, a noted architect of his day, upon the model of the Pantheon at Rome. It was the fifth medical school in the United States in point of age. It had the usual vicissitudes of medical schools, being at first without buildings, money, facilities for teaching or a library. Later came a long-continued controversy between the Regents and Trustees which divided the faculty and students, and was only settled by an appeal to the courts. Subsequently the Civil War interfered much with its prosperity and development. Notwithstanding all of these disadvantages the University of Maryland has done a most useful work, and has left an abiding impress upon the medical education of the country. The founders purchased with their private means, a library; they procured costly apparatus from Europe; later they effected a loan and erected another building for lecturing purposes and for the accommodation of the splendid anatomical and pathological collection of over 1,000 specimens which

they had bought; early recognizing the need of facilities for clinical instruction, they leased ground in the immediate vicinity of the college, and erected thereon a costly hospital (being among the first to do this); they encouraged classical learning by founding a gold medal for Latin theses and in other ways. Their successors introduced hygiene and medical jurisprudence into their curriculum (1833); they endeavored to increase the opportunities for instruction by voluntarily lengthening their course to six months (1840); they early taught auscultation and percussion (1841); they instituted lectures on pharmacy (1844); they gave a complete course on operative surgery (1845) and pathology (1847); they encouraged preparatory medical schools; they were either first or second to enforce dissection (1833, 1848); they established compulsory courses in experimental physiology and microscopy (1854); they were among the first to introduce the study of specialties (1866), and first to make an independent chair of diseases of women and children; they established a successful dental school (1882), a lying-in-hospital (1887), and a training school for nurses (1890).

In 1812 the Legislature, by a special act, gave authority to add, Faculties of Divinity, Law and Arts and Sciences. Of these additional faculties, that of Law alone remains. This had an uncertain existence for many years, but in 1870 it was reorganized and it became an important part of the University. It now occupies a building of its own adjoining the medical college on Lombard street. It has seven professors and about 100 students. In 1882 a dental school was founded which

occupies a building adjacent to the University on Greene street. It now has seven professors and gives instruction to about 150 students annually.

THE JOHNS HOPKINS UNIVERSITY.[1]

FOUNDATION.

The Johns Hopkins University owes its foundation to the liberality of the Baltimore merchant whose name it bears. He died on the twenty-fourth of December, 1873, nearly eighty years of age, leaving a large fortune, most of which he gave in two nearly equal amounts for the endowment of a University and a Hospital. He directed that when the Hospital was completed, it should become a part of the Medical School of the University. Many years before his death he began to cherish the idea of establishing these two institutions, and the letter of instructions signed by him shows the broad and enlightened views which he held with respect to the welfare of mankind. At the same time his specific bequests were made in very simple terms, and he left to his Trustees the decision of all details.

The University was incorporated under the general laws of the State of Maryland before the death of the founder, and soon after his death the Trustees held their first business meeting, on the 6th of February, 1874. The first President of the University, who is still in office, was elected in December of that year, and entered upon his duties in the following May. The work of

[1] By President D. C. Gilman.

instruction began in the autumn of 1876, and has gradually extended and improved since that time.

METHODS.

The University is organized upon the principle that it is a body of teachers and scholars, *Universitas magistrorum et discipulorum*,—a corporation maintained for the conservation and advancement of knowledge, in which those who have been thoroughly prepared for higher studies are encouraged to continue, under competent professors, their intellectual advancement in many branches of science and literature.

In this society are recognized two important grades; the Collegiate students, who are aspirants for the diploma of Bachelor of Arts, to which they look forward as a certificate that they have completed a liberal course of preliminary study,—and the University students, including the few who may be candidates for a higher diploma, that of Doctor or Master (a certificate that they have made special attainments in certain branches of knowledge), and a large number who, without any reference to a degree, are simply continuing their studies for varying periods.

Corresponding to the wants of these two classes of students, there are two methods of instruction—the rule of the College which provides discipline, drill, training in appointed tasks, for definite periods; and the rule of the University, the note of which is opportunity, freedom, encouragement and guidance in more difficult studies, inquiries and pursuits. Thus far but one faculty has been

maintained—that of philosophy or the liberal arts—but the nucleus of a medical faculty has been formed, and some advanced instruction is now given in pathology and in the special branches of medicine and surgery, under the auspices and in the buildings of the Johns Hopkins Hospital.

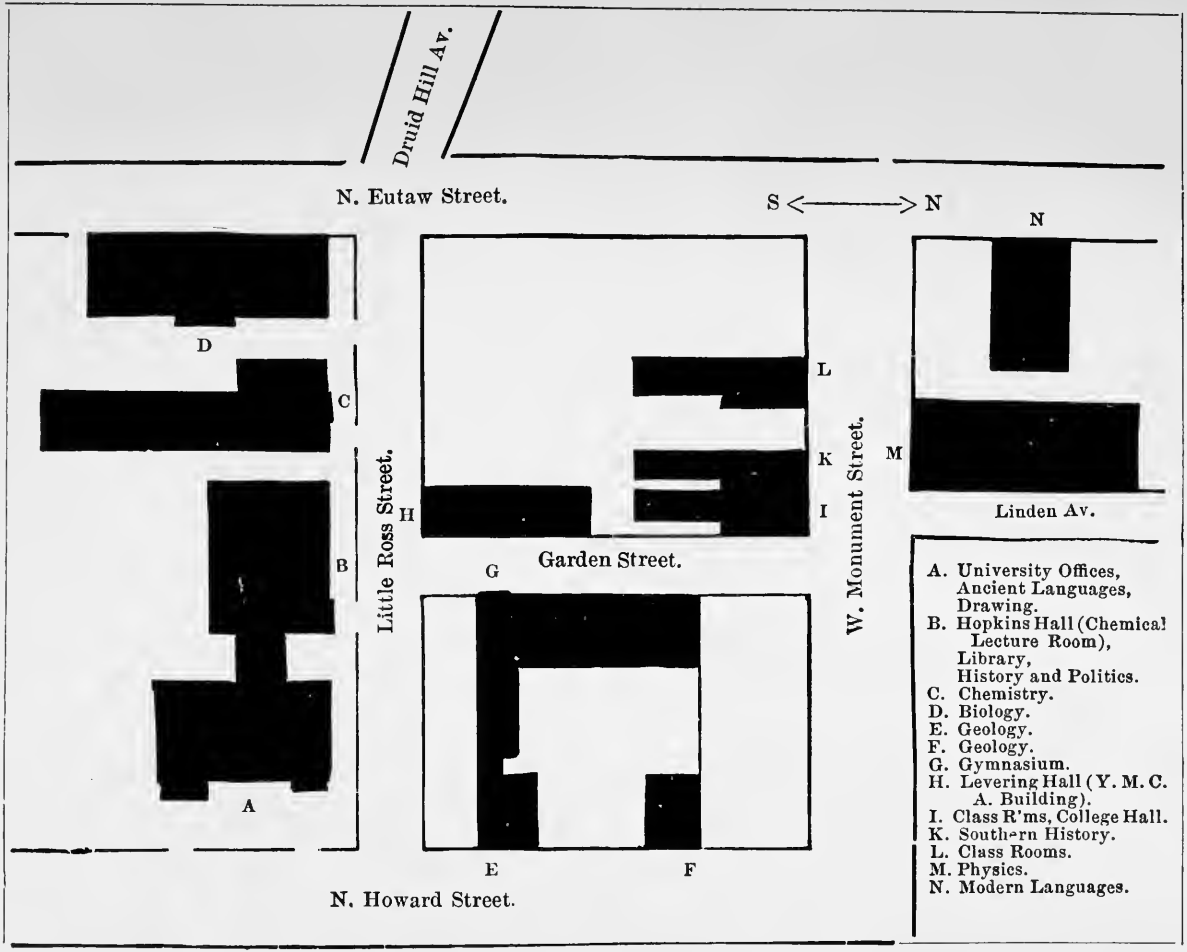
STATISTICS.

The following numerical statements may be of interest:

The academic staff includes (January, 1892) fifty-seven teachers, in addition to a number of students who conduct classes in various departments. The number of students enrolled is five hundred and twenty-four, of whom two hundred and sixty-two are residents of Maryland, two hundred and fifty are from thirty-four other States of the Union, and twelve from six foreign countries. Among the students are three hundred and fifteen already graduated, coming from one hundred and forty-five colleges and universities; there are one hundred and thirty-eight matriculates (or candidates for the degree of Bachelor of Arts); and there are seventy-one admitted as special students, to pursue courses of study for which they seem fitted, without reference to graduation.

During the year 1890–91 the degree of Bachelor of Arts was conferred upon fifty candidates, and twenty-eight candidates were promoted to the degree of Doctor of Philosophy.

During the first fifteen years (1876–91), seventeen hundred and sixty-seven individuals were enrolled as students, of whom seven hundred and seventy are registered as from Maryland (including six hundred and



PLAN OF ARRANGEMENT OF THE JOHNS HOPKINS UNIVERSITY BUILDINGS.

twenty-four from Baltimore), and nine hundred and ninety-seven from fifty-two other States and countries. Nine hundred and ninety-four persons entered as graduate students, and seven hundred and seventy-three entered as undergraduates. Of the undergraduates, one hundred and sixty continued as graduate students, many of them proceeding to the degree of Doctor of Philosophy. It thus appears that eleven hundred and fifty-four persons have followed graduate studies here in the last fifteen years.

Since degrees were first conferred, in 1878, three hundred persons have attained the Baccalaureate degree, and two hundred and twelve have been advanced to the degree of Doctor of Philosophy.

BUILDINGS.

The University Buildings are placed in the heart of the city, within sight of Washington Monument, and near to a large number of literary and educational establishments. They include a central building, in which are the offices of administration and the class rooms for the ancient languages. Directly west is a building containing the general Library of the University and a large lecture room for Chemistry. Beyond this, to the west, stands the Chemical Laboratory, a very convenient and well-equipped establishment; and still further to the west is the Biological Laboratory, likewise a three-story building, in which all the best modern appliances are found for the study of the biological sciences. North of the main group of buildings stand the Gymnasium (with

the accessory bath-rooms and dressing-rooms and a tennis court), and Levering Hall, erected for the Young Men's Christian Association of the University.

Still further north is the largest and best of all the buildings yet constructed, the Physical Laboratory, in which are housed the departments of Physics (including Electrical Engineering), Mathematics and Astronomy.

Several dwelling houses in the neighborhood are also used for class-rooms and for the laboratories in Mineralogy and Geology.

A new building, to be used for the library and for class-rooms for the literary departments, is to be erected at an early date, on the corner of Monument and Garden streets, extending in a southerly direction to Little Ross street.

THE WOMAN'S COLLEGE.[1]

The most distinctive architectural feature of that portion of Baltimore which has lately been included within the corporate limits is a line of massive granite buildings on St. Paul Street, flanked on the south by a lofty tower of peculiar shape. The tower belongs to the First Methodist Episcopal Church and the buildings marshalled to the north of it are those of the Woman's College of Baltimore. They consist of Goucher Hall, containing over forty class-rooms, laboratories and offices for administration, and Bennett Hall, containing the gymnasium, baths and swimming pool. A block to the east,

[1] By President J. F. Goucher.

at the corner of Calvert and Fourth Streets, is the "College Home," a plain but handsome brick building, accommodating sixty-five students. A block to the west, on the corner of Charles and Fourth Streets, a second home of similar style and capacity has just been begun and will be ready for occupancy, it is hoped, by the beginning of next year. On the north-east corner of St. Paul and Fifth Streets ground has just been broken for another building similar in style to Goucher and Bennett Halls. This is to be ready for use by September, 1893, and will be occupied by the Girl's Latin School—the preparatory department of the College.

The President of the College is Rev. John F. Goucher, D. D., to whom the College owes most of what it is. He exercises the general direction and control in its policy and government, and is ably supported in the work of active instruction by a staff of twenty-seven professors and instructors. The heads of the various departments of study are specialists in the work intrusted to their charge. Professor William H. Shelley is Principal of the Latin School.

The College was incorporated January 26, 1885, and was opened for students September 18, 1888. The total number of students in both departments is about three hundred and fifty, of whom ninety are doing strictly collegiate work. Of these ninety only thirty-nine are residents of Baltimore and twelve of the rest of Maryland; ten come from the other Southern States, nineteen from the Middle States, six from the Western States east of the Mississippi, and four from those west of the Mississippi.

The Curriculum is abreast of the most advanced ideas in education. The elective system receives full recognition in fourteen possible groups of studies each of which leads to the degree of Bachelor of Arts. This grouping of the studies prevents injudicious, arbitrary and capricious selections, while it enables a student to direct her studies towards the Classics, Modern Languages, Mathematics, Science or History.

A quotation from the latest Program of the College may appropriately complete this notice:

The Woman's College of Baltimore aims to offer young women who seek higher education the best facilities for its pursuit under conditions equally favorable to their physical and their moral welfare. It was founded in 1884 by the Baltimore Conference of the Methodist Episcopal Church and is conducted under its control. Its discipline is such as is approved by that branch of the Protestant Church. It is not sectarian in any other sense than this. Its instructors are selected for their ability without regard to their church relations and it welcomes students of every faith to the advantages that it provides. No influence is exerted directly or indirectly to determine the denominational preferences of students; but the New Testament ideal of character is presented and every legitimate influence brought to bear in order to secure its development.

OTHER EDUCATIONAL INSTITUTIONS.

The College of Physicians and Surgeons.—This institution commenced in 1872 with 43 students. During its last session it had 472 students and conferred the degree of M. D. on 109. Its handsome new building recently completed is on the corner of Calvert and Saratoga streets. It has a faculty of eleven professors and fourteen assistants. It exercises exclusive control over the Baltimore City Hospital whose new building adjoins its own; and over the Maryland Lying-in Asylum. It also has the privileges of Bay View Asylum, Hebrew Hospital, Children's Nursery and Hospital, and other institutions.

The Baltimore Medical College, on Howard street above Madison, has entire control of the Maryland General Hospital on Linden Avenue, with its Eye and Ear and Lying-in departments. It has a faculty of eleven professors and nine assistants. Its students last year numbered 124, of whom 52 were graduated.

Baltimore University consists of a School of Medicine, with dental and veterinary departments, and a Law School. The first named department, on North Bond street near Baltimore Street, has a faculty of twelve professors. During last year there were 74 students in attendance, of whom 32 were graduated.

The Woman's Medical College of Baltimore was started in 1882. It is situated on Druid Hill Avenue, corner of Hoffman street. The Hospital of the Good Samaritan is under its control. Its faculty numbers twelve professors with many lecturers and assistants. Twenty-two students were in attendance during its last session.

THE JOHNS HOPKINS HOSPITAL.[1]

Johns Hopkins, the founder of the Johns Hopkins Hospital, was a merchant of Baltimore, who was born in Anne Arundel County, May 19th, 1795. He came to Baltimore to reside when a lad of seventeen years, and was afterwards, until his death fully identified with the business interests of this city.

During the three years which followed his death, the Trustees were busily engaged in procuring plans for the Hospital from many experts in hospital construction, which were finally adopted April 17th, 1877. Excavations were begun June 23d, 1877, and the work of construction consumed the following twelve years. The completed Hospital was formally opened with appropriate ceremonies May 7th, 1889.

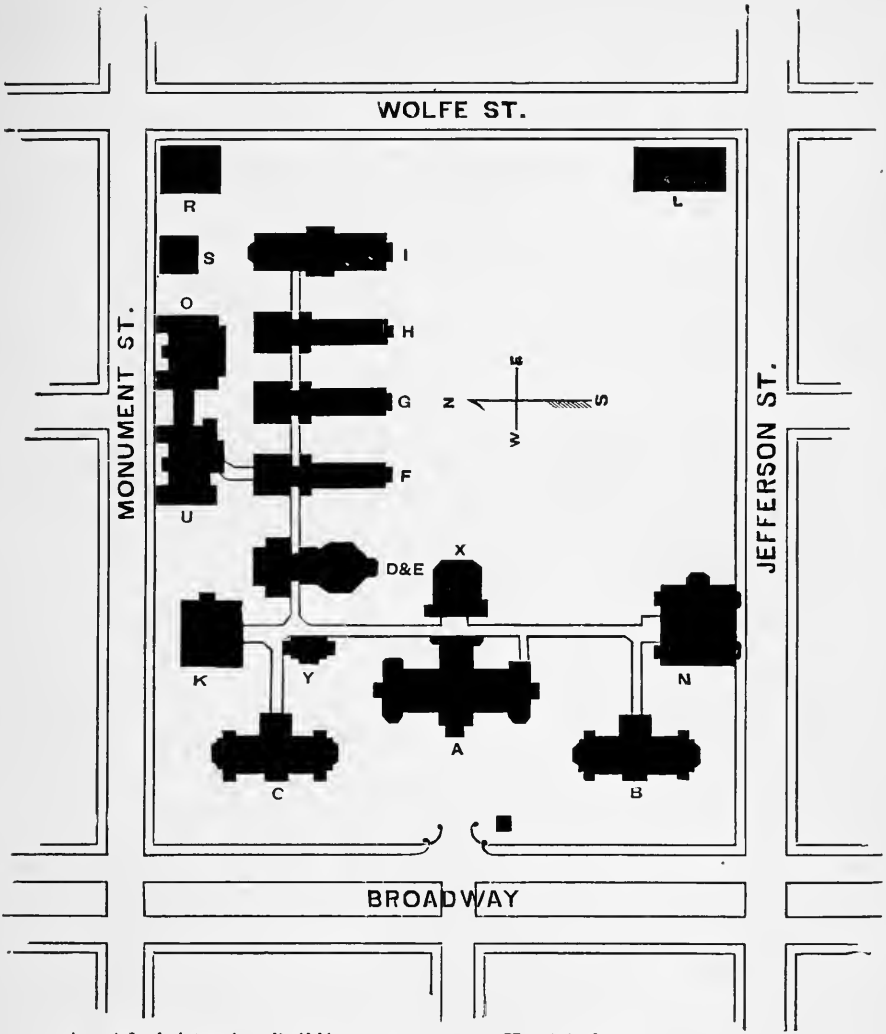
The opposite plate shows the location of the buildings upon the grounds and their designs.

The grounds of the Hospital include four entire blocks, containing about fourteen acres, having a frontage on Broadway of 709 ft., and extending back 356 ft. Elevation at gateway, 94 ft. above mean tide, at base of main building, 108 ft., and rising in rear to 115 ft.

CONSTRUCTION OF BUILDINGS.

The buildings having a special relation to the educational features of the institution—namely, the Amphitheatre, Dispensary and Pathological Laboratory—are located on the northeast portion of the grounds near the

[1] By Dr. H. M. Hurd.



A.—Administration Building.
B.—Female Pay-Ward.
C.—Male Pay-Ward.
D.—Male Surgical Ward.
E.—Female Surgical Ward.
F.—Male Medical Ward.
G.—Female Medical Ward.
H.—Gynaecological Ward.
I.—Isolating Ward.
K.—Kitchen.
L.—Laundry.
N.—Nurses' Home.
O.—Dispensary.
R.—Pathological Building.
S.—Stable.
U.—Amphitheatre.
X.—Apothecary's Building.
Y.—Bath-House.

PLAN OF ARRANGEMENT OF THE JOHNS HOPKINS HOSPITAL BUILDINGS.

land owned by the Johns Hopkins University, upon which the buildings of the Medical Department are to be placed. In addition to the buildings shown on the block plan, the original plan of the institution provides for a row of five wards on the south side opposite to, and corresponding with, the row of buildings on the north side of the lot. All the buildings except the gate lodge, the pathological laboratory, the laundry and the stable, are connected by a covered corridor, the floor of which is at a uniform level of 114 feet above mean tide. The top of this corridor forms an open terrace walk at a uniform level of 124 feet above mean tide. Beneath the covered corridor is a passage-way, containing the pipes for heating, lighting, water supply, sewage, etc., which is called the pipe tunnel, and is really a half-basement passage rather than a tunnel. The buildings are constructed of brick, with trimmings of Cheat River stone and moulded terra-cotta. Those on the main, or west front, are constructed of the best quality of pressed brick. The foundations of the principal buildings are of a solid concrete base, or of broad flags of Port Deposit granite. All foundation and interior walls are of hard brick, laid in Cumberland cement below the ground level, and covered by a layer of heavy slate. Lines of drain tile are laid around the foundations, and all buildings having cellars or half-basements have the outer surface of the wall covered with overlapping slates. Above the horizontal layers of slate, the walls are hollow, with a two-inch air space.

All pitched roofs are covered with carefully selected Peach Bottom slate laid on English asphalt felt, and secured with copper nails. The flat portions of the roofs

are covered with copper, which is also used for gutters, flashings and downspouts. The floors of the principal buildings are formed of moulded hollow blocks of hydraulic lime of Teil, laid between iron beams of suitable size. They are fire-proof and are much lighter than those constructed with solid brick arches. The floors of the basements are of artificial stone laid in large blocks, and underneath all heat coils is placed a heavy coat of asphalt to prevent the leakage of ground air through the coil. The floors of all wards and rooms for the sick are of edge grain Georgia pine $1\frac{1}{8}$ inches thick, which was soaked in water for six months and then preserved dry for several years before it was dressed for use.

All walls are plastered in three coats, and finished with hard troweled sand finish. In the Pathological Laboratory, bath-house and one pay ward, the finish is composed of finely-ground soapstone with plaster of Paris. In all rooms where wooden beams have been used for the ceilings, wire netting has been used in place of wooden laths to secure a semi-fireproof construction. The stairways are of iron with a layer of asphalt in the treads. Window-sills are of slate. All woodwork is of ash with plain bevelled or rounded mouldings.

HEATING AND VENTILATION.

The system of heating is that known as a "hot water system," and consists of a network of iron pipes through which circulates hot water of comparatively low pressure and temperature. The heat is furnished by two sets of boilers—the one set comprising four boilers is located

THE JOHNS HOPKINS HOSPITAL.

under the kitchen at the northern side of the buildings; the other, consisting of two boilers of the same size, is located under the Nurses' Home at the south extremity of the system.

From these boilers the heated water passes out through the main delivery pipes which are of cast iron with an inside diameter of 26 inches. From these "mains" branches are given off to each building. These branches in turn give off smaller branches to supply the coils over which the air to be heated passes. From these coils the water which has been cooled in heating the air returns to the boilers by a second system of pipes exactly analogous to that just described, except that it is located on a lower level. The circuit is, therefore, a closed one, none of the water being drawn off or used at any point.

To prevent loss of heat the entire system of mains and branches is insulated by a non-conducting medium composed of felt, asbestos and painted canvas. At the terminal branches, that is, the coils, this envelope is omitted so that the air comes in immediate contact with the surfaces of the heated iron pipes.

The force which sets the water in circulation is the difference in weight between the heated water which passes out from the boilers and the cooled water which leaves the coils on its return to the boilers. The two columns of water being of equal height, but of different temperatures (the difference ordinarily being from 8°–15° F.), have, therefore, different specific gravities.

By means of valves upon the mains, the branches and the coils, the velocity of the flow and consequently the amount of heat required in any building, or at a given

point in that building, may easily be regulated—indeed, by proper adjustment of these valves the amount of heat given off by one coil, that is, the amount of heat passing into one register in the ward may be made greater or less than that passing in through the neighboring register.

The entire system contains about 175,000 gallons of water and produces an equable agreeable temperature in all the buildings to which it is distributed under all conditions of cold weather and with the fullest ventilation.

The system of ventilation which is inseparable from the heating depends for its force, like the circulating water, upon the difference in specific gravity between equal volumes of air of different temperatures. Under each ward are 12 of the coils above referred to. Each coil is located in a brick flue, which conducts the air upward over the coil and into a register with a clear opening of one square foot located in the wall of the ward just above the floor and between the beds. At the bottom of each of these flues are two openings—one admitting air directly from outside—the other admitting air from the basement, or ventilating chamber as we prefer to call it, the whole room being intended for the purpose and used for nothing else.

The two openings are provided lest that in windy weather the air blowing directly against the outside wall-opening may give rise to draughts in the wards; whereas if this outside opening be closed and the air be admitted to the ventilating chamber (a basement which is all above ground) through windows, its direct force will be destroyed and it will be admitted through the

inside opening of the flues and pass into the wards without draughts.

After circulating in the wards it passes out through openings in the floor under each bed. These openings are all brought into communication, by means of flues, with a large common duct or trunk-flue which passes into the lower part of an aspirating chimney about 70 feet in height in the upper portion of which is located a steam coil. The temperature constantly maintained in this coil is such that there is at all times a strong upward draught in this shaft.

The wall registers, those delivering fresh air to the wards, are so constructed that they can never be shut off. The temperature of the air passing in through these registers may be regulated by means of a lever, the key to which is in the possession of the nurse in charge of the ward, so that either the extremes of cold or warm air, or air of moderate temperature may be admitted as may be desirable, but at no time can the air be prevented from passing into the room.

Another device which exists in the common wards is the flushing-opening in the ceiling. In the ceiling of each ward are five openings each of 2 sq. ft. area controlled by a lever in the vestibule of the ward. The object of these openings is the liberation of over-heated air and experiment has shown that at such times as the heat is too great for comfort the temperature in the ward can easily be brought to a point of comfort in ten or fifteen minutes by opening these ventilators. Ordinarily these openings are kept closed.

The object aimed at in this system of ventilation and

heating has been to supply to each individual occupying the ward at least one cubic foot of fresh air per second of such a temperature as to give rise at no time to feelings of discomfort; and this end has been gained.

THE SHEPPARD ASYLUM.[1]

Among the many notable institutions in Baltimore and vicinity for the relief of the sick or the care of the helpless, the Sheppard Asylum deserves special notice.

This institution is situated at Sheppard Station on the Baltimore and Lehigh R. R., six miles north of the city.

The buildings are surrounded by an estate of 377 acres of rolling land. The grounds of the institution already present, owing to the natural resources of the situation, the appearance of a well-ordered park, and the further ornamentation which is proposed, with additional drives, paths, lawns and lakes, will make the place one of the most attractive in the country.

The institution was founded by the late Moses Sheppard of Baltimore, and from the "announcement" recently issued by the Trustees, the following is taken:

"Moses Sheppard organized his own Board of Trustees in 1853, had them incorporated by the State of Maryland, to which they are held 'to a strict and frequent accountability,' with remedies provided for 'remissness or perverted action.' He held meetings with them for several years, and a few months before his death, in February, 1857, he had John Saurin Norris appointed in his place as their President.

[1] By Dr. E. N. Brush.

"The bequest, by his will, was to the Trustees thus created, to whom the estate was given untrammeled by conditions or restrictions. It then amounted to $567,632.40. It is now $666,930.37. The intention of the founder was communicated by him, personally, to his Trustees, has been transmitted to this date, to the present Board, and has been closely followed. But besides this traditional knowledge, there are in writing memoranda left by him, the principal features of which are as follows:

"'My leading purpose is to found an institution to carry forward and improve the ameliorated system of treatment of the insane irrespective of expense,' and 'that the income and not the principal shall be used,' and 'that the increased cost of preparation and attendance will limit the number of patients, that each patient shall have an attendant when it may appear useful—an experimental establishment. Let all that is done be for use strictly and not for show.'

"His design was for a hospital for the *cure of the insane,* and not an asylum for the care and safe keeping of chronic cases.

* * * * * * *

"The Asylum buildings are fire-proof, having iron stairways, floors of brick arched on iron girders, and slate roofs. The two wings—east and west—are alike, are separated by a space of 100 feet, are intended one for each sex. They are each 360 feet long, each having a south wing 100 feet long. In different parts they are of one, two and three stories, with attics over all, with basement story under all, and subways under the basement. In the subways, connected by tunnel with the laundry build-

ing (400 feet south), are the steam and water pipes, and the radiating heaters. The laundry building contains in its basement the steam boilers, hot water fixtures, and room for engines, dynamos, forcing fan for fresh air through the tunnel, etc. It has a tower 90 feet high, on which are water tanks of 18,000 gallons capacity, into which will be pumped very pure water from several large springs on the property, concentrated into a reservoir in the woods 1,600 feet south of the building. These tanks will distribute water to the highest parts of the buildings. Two large cemented cisterns underground—of 60,000 gallons each—collect rain water from the slate roofs, to be used in the boilers and for laundry purposes."

The plans for the buildings were prepared by the well-known architect Mr. Calvert Vaux, of New York, and, as carried out, present a building which in many respects is in advance of any similar institution in the United States.

The parlors, corridors and bed-rooms are large and well lighted, and each division is supplied with one or more large sun-rooms, made bright and cheerful by flowers and plants, and having a pleasant and extensive outlook.

The lighting is by electricity—the Edison system—and the lights have been so arranged that every room occupied by patients is well illuminated.

The furnishing has been done with a view of increasing, as far as possible, the cheerful and home-like appearance of the institution, and of adding to the comfort and pleasure of the inmates.

The sanitary arrangements have been carefully considered and all of the interior plumbing has been done

under the immediate supervision of the medical superintendent.

Persons even not immediately interested in the care of the insane or in general hospital construction and management will be repaid by a visit to the Sheppard Asylum, which affords an excellent example of thoroughness of construction both in exterior and interior detail, and of the most careful adaptation of constructive means to a special end.

The Trustees of the Asylum are George A. Pope, *President;* Gerard T. Hopkins, J. Olney Norris, Charles C. Homer, E. Glenn Perine, Charles H. Riley, M. D., George M. Lamb. The medical service and general administration are under the control of the Physician-in-Chief and Superintendent, Dr. Edward N. Brush.

The institution has been open for patients since December last.

WATER SUPPLY.

The water supply of Baltimore, as is well known, is one of the largest and in many respects one of the finest in the country. The water is of the purest quality and calculated to be sufficient for a population of over a million.

The supply is derived from the Gunpowder river and Jones' Falls. There are six reservoirs in the system and over 200 miles of pipes run beneath the streets of the city, supplying about 50,000 houses, 1,000 hydrants, and 15,000 special needs, baths, etc.

The following extract from the *Baltimore American*, of May 18th, 1884, will show the details and cost of construction of the water works. It may be well to add that

the figures and matter contained in the article were carefully prepared by the chief engineer of the department and his assistant.

LAKES ON JONES' FALLS AND THE GUNPOWDER RIVER.

In addition to the Gunpowder supply, Baltimore also receives water from the Jones' Falls supply, which embraces Lake Roland, 225 feet above tide, one and a half miles long, with an average width of one-eighth of a mile and a water surface of 116 acres; a conduit four miles long; Hampden Reservoir, 217 feet above tide and eight acres water surface; Druid Lake, in Druid Hill Park, 217 feet above tide, depth twenty to sixty-five feet, with fifty-three acres of water surface, surrounded by a drive of one and a half miles; High Service Reservoir, 350 feet above tide, with a water surface of four acres; Mount Royal Reservoir, 150 feet above tide, with a water surface of five acres.

Loch Raven, the lake on the Gunpowder river, was begun December 22d, 1875, and completed November, 1880. The lake is four and three-fourths miles in length; the elevation of water surface at high-water mark is one hundred and seventy feet above tide. The width of the lake is from one hundred feet to eight hundred feet; it covers an area of water surface of 252 acres, and is from four to twenty feet in depth. The capacity of the lake is 510,000,000 gallons, and it is surrounded by a roadway from thirty feet to fifty feet in width; the elevation of the surface of this roadway is one hundred and eighty feet above tide.

Nine bridges span the streams emptying into the lake, and all, with one exception, are of marble.

Concrete and masonry, 91.85 perches laid at $3 per perch; rubble masonry, 3,980.89 perches, at $4 per perch; rough hammered masonry, 436.46 perches, at $4.75 per perch. Total number of cubic yards of earth excavated, 688,207, at 16 cents per cubic yard; loose rock, 99,777.41 cubic yards, at 38 cents; solid rock, 77,973 cubic yards, at 60 cents.

LOCH RAVEN DAM AND GATE HOUSE.

The dam was commenced December 3d, 1875, and completed October 6, 1881. It is built of rubble and cut stone, and the masonry cost $255,950.57. The width of the overfall is 300 feet, number of stones in face of the dam 2,530, the dimensions of each being about 25 cubic feet. The height of the dam from foundation to crest line is 29 feet, the thickness of the foundation is 62 feet, depth of the foundation below original surface is 13 feet. The north wing wall of the dam is 205 feet in length; length of north retaining wall 197.3 feet, south retaining wall 200 feet.

The flow of water at the dam is controlled by a gate-house, the chambers of which are built of white marble. The gate-house superstructure is a parallelogram in form.

The width of the gate-house superstructure is 45½ feet, length 70 feet, thickness of walls 2 feet 6 inches, cost of constructing walls of superstructure $7,890. Within the gate-house are located seventeen gates, with openings 3 by 4 feet, costing $398 per gate.

GRADUATION AND MASONRY.

Earth excavations, 117,175 cubic yards, at 18 cents; loose rock, 37,192 cubic yards, at 40 cents; solid rock, 19,816 cubic yards, at 75 cents; concrete masonry, 463.44 perches, average price $2.25 per perch; rubble masonry, 13,219.20 perches, at $5.57; rock ashlar masonry, 4,549.62 perches, average price $16.53; dressed ashlar, 1,706.39 perches, at $24.65; rock hammered masonry, 437.35 perches, at $6.

THE MAIN TUNNEL.

The tunnel connecting Loch Raven with Lake Montebello was commenced December 15, 1875, and completed November, 1880. Its length from the portal in Loch Raven gate-house to portal in Montebello gate-house is 36,443 feet, or 517 feet less than seven miles. It is a circular bore, with an internal diameter of twelve feet, and a fall of one foot to the mile. For 24,752 feet, or nearly four and a half miles, its course is through hard rock, which required no arching, and where the drifts had to be pushed by hand-drilling and dynamite blasting. The remaining 11,691 feet, or about one hundred feet more than two miles, is arched with bricks. The cost of graduation was $1,382,598.93; arching, cleaning up tunnel, filling shafts, $397,011.32. The total cost of the main tunnel was $1,779,610.24. The capacity of discharge of the tunnel per twenty-four hours is 170,000,000 gallons. The depth of the bottom grade below the surface is from 36 feet to 354 feet. In the construction of the

tunnel fifteen shafts were sunk, and they were located at an average distance of 2,337 feet apart on center line of tunnel and parallel to its axis. The longest drive between shafts was 3,075 feet, and the minimum 1,890 feet. The maximum depth of shafting sunk in hard rock per month was 37.5 feet; minimum depth in hard rock per month, 15.5 feet; maximum depth in soft rock per month, 44 feet; minimum, 38 feet. Number of lineal feet of shafting, 2.354 feet; dimension of shafts in rock excavation, from 17 feet by 8 feet to 20 feet by 8 feet. Greatest depth of shaft 294.91 feet. The total number of cubic yards of shafting in main tunnel was 19,256; average price paid per cubic yard of shafting, $10.03.

Drifting.—In heading the maximum distance driven in hard rock was 114 feet per month; minimum, 10 feet. Maximum distance driven in soft rock per month 170 feet; minimum, 12 feet. In bottom, maximum distance driven in soft rock per month, 300 feet; minimum, 10 feet. Maximum distance driven in hard rock per month, 112 feet; minimum, 12 feet. Maximum distance driven in hard rock in full area of tunnel per month, 80 feet; minimum, 10 feet. Total number of cubic yards of drifting on main tunnel, 176,579; average price paid per cubic yard for drifting, $6.62.

Cost of brick work per perch, done by day's labor, $15; number of perches of brick work per lineal foot in arch and invert, exclusive of arching over the shafts, 2.07; cost of brick work per lineal foot in arch and invert done by day's labor, $31.05.

LAKE MONTEBELLO.

Lake Montebello was commenced December 1, 1875, and completed December, 1880. It is the receiving reservoir of the Gunpowder water supply. The lake is irregular in shape, is 163 feet above mean tide, with a water surface of 59 acres, a depth of water of 30 feet, and a drive of an average width of 70 feet, and 7,265 feet long. The capacity of the lake is 496,378,144 gallons. There are 29 gates in gate houses, size of each three by four feet, costing $398 each. The drain tunnel is 3,432 feet in length, and required about a year and a half to construct. It is circular in form, with an internal diameter of nine feet; 2,873 feet of the tunnel is arched with brick, and 512 feet is in solid rock. The depth of the tunnel below the surface is 28 to 62 feet; fall of tunnel per 100 feet .085 feet; fall of tunnel from west to east portal 29.6 feet; number of shafts, including air shaft, 3; average depth of shafts below the surface, 43 feet; perches per lineal foot of brick work in arch and invert, done by contract, 1.26; cost of brick work per lineal foot by contract and exclusive of arching over shafts, $13.23; number of perches of brick work done by contract, 3,721, at $10.50 per perch. Total cost of drain tunnel, $97,102.96.

THE CONDUITS.

The supply of water for the city, after it leaves the gate-house at Lake Montebello is conveyed in a conduit, built partly in tunnel and partly in open cut, a distance of

5,410 feet, to the gate-house at Lake Clifton. The conduit was commenced August, 1876, and completed August, 1878. It is circular and arched with brick, and has an internal diameter of twelve feet. Only one shaft was sunk, at a depth of 33.5 feet below the surface. The depth of the conduit below the surface is from 29 feet to 110 feet. The cost of drifting, including packing over arch, by contract was $4.50 per cubic yard; cost of brick work per perch, done by day's work in open cut of tunnel, $9.58; in tunnel, $12.75; cost of brick work per lineal foot in open cut, $25.48; in tunnel, $37.74; perches of, in arch and invert, 2.96; perches in open cut, 2.66.

There is also an elliptical conduit, constructed during October, November and December of 1877, which is 198.5 feet in length, with a long axis of 18 feet, and short axis of 12 feet. Approach to conduit 51.5 feet in length. Discharge conduit, 1,083 feet in length, with an internal diameter of 12 feet, constructed partly in excavation and partly in embankment. Earth excavation, 719,318 cubic yards, at 21 cents per cubic yard; loose rock, 156,405 cubic yards, at 24 cents; puddling, 65,599 cubic yards, at 15 cents; concrete masonry, 98 perches, at $2.75; rubble, 16.95 perches, at $5.00. Gate-house superstructure is a hexagon in form. Length of each side, 41 feet; thickness of walls, $2\frac{1}{2}$ feet; cost of building walls of superstructure, $14,923.75.

LAKE CLIFTON.

This lake was constructed in 1884 as a storage reservoir, and is located just beyond the old city limits, about one

mile south of Montebello, from which it receives its water through a twelve foot conduit. Six distributing mains, each forty inches in diameter, bring the water to the distributing mains in the city.

Ground was broken for the permanent water supply on December 3, 1875, by Civil Engineer Robert K. Martin. The two systems of Jones' Falls and Gunpowder river are capable of furnishing daily a supply of about 165,000,000 gallons of water. To this must be added the sum total of the reservoirs and aqueducts, as follows:

Jones' Falls.—Lake Roland, 400,000,000; conduit (daily), 3,500,000; Hampden reservoir, 46,000,000; Druid Lake, 429,000,000; High Service reservoir, 27,000,000; Mount Royal, 30,000,000; total 935,500,000.

Gunpowder.—Loch Raven, 1,500,000,000; conduit (daily), 30,000,000; Montebello, 500,000,000; Clifton, 265,000,000; total, 2,170,000,000. Grand total, 3,105,500,000 gallons.

The cost of the Gunpowder supply, exclusive of Lake Clifton, for which $500,000 in bonds have been issued, was about $4,500,000, and the total cost of the two systems about $10,000,000.

BALTIMORE INDUSTRIES WHICH MANUFACTURE MINERAL PRODUCTS.

It has seemed proper to include in this Guide some account of those industries in Baltimore which employ the various mineral products occurring near the city as their raw material. To this list has also been added a brief notice of the more important plants which extensively manufacture metal.

The following account of the mineral production of Maryland in 1889 has been compiled from the still unpublished returns of the eleventh U. S. Census, by Dr. David T. Day, Chief of the Division of Mining Statistics in the U. S. Geological Survey. It will form an interesting introduction to the notices of Baltimore's industries, as well as a valuable addition to what is said on the subject of economic minerals under the head of Geology.

MINERAL PRODUCTS OF MARYLAND IN 1889.

Substances.	Quantity.	Value.
Gold (troy ounces)	501	$ 10,369
Bituminous coal (short tons)	2,939,715	2,517,474
Iron ores (long tons)	[1] 29,380	68,240

[1] Including a small product from Delaware.

Substances.	Quantity.	Value.
Mineral waters (gallons sold)	74,160	$ 12,057
Granitic rocks (cubic feet)	3,371,032	447,489
Marble (cubic feet)	333,305	139,816
Slate	.....	110,008
Sandstone (cubic feet)	508,325	10,605
Limestone	.....	164,860
Potters' clay (short tons)	13,870	52,920
Infusorial earth (short tons)	3,050	10,700
Soapstone (short tons)	432	4,321
Ochre (short tons)	616	12,000
Flint (short tons)	8,632	46,828
Brick (number)	125,000,000	1,000,000
Unspecified	.....	550,000
Total		$5,157,687

This total places Maryland 26th among the States.

Coal.—Coal mining is limited to the western extremity of the State in Garrett and Allegany counties. The main field, called Cumberland or George's creek, is about 4 miles wide along the Baltimore and Ohio railroad where it is cut by the Savage river and the Northern branch of the Potomac. It extends thence into Pennsylvania, decreasing in breadth until it dies out. This field, so limited in extent, is nevertheless one of the most inportant of the country, deriving this rank from the great thickness of its seams and the purity of the fuel. The thickness of its beds is indicated by the name "Big" or "14–foot vein" given to the principal seam, which usually yields 10 feet of mined coal. Mining was in progress in 1842 and reached an annual output of a million tons in 1866; in 1888 over three million tons were produced and in 1890 the product was 2,998,047

tons. The enormous total of 64,797,273 tons has been mined altogether. The facilities for marketing the coal have been an important feature in the great development of the field. The routes are as follows: The Baltimore and Ohio railroad to Baltimore; the Chesapeake and Ohio canal to Georgetown, D. C.; the Pennsylvania railroad; the George's Creek and Cumberland railroad; and the West Virginia Central and Pittsburgh railroad.

In composition the coal averages about 75 per cent. of fixed carbon, 15 per cent. of volatile matter and about 10 per cent. of ash, thus placing it between semi-anthracite coal and the bituminous coal of western Pennsylvania. The volatile matter is sufficient for it to burn with a long flame but not great enough to give trouble from soot. Hence it has come to be the standard coal for use in steam boilers.

Iron ores.—The carbonate ores found in Cecil, Harford, Baltimore, Howard, Anne Arundel and Prince George's counties have yielded a very considerable product from many small mines, usually open cuts. At present the product is small, but still enough to supply several furnaces, especially that at Muirkirk from which a well-known brand of foundry iron is made. In composition the ores range from 40 to 46 per cent. of iron and 0.06 to 0.3 per cent. of phosphorus. In 1880 the iron ore product of Maryland was 124,667 long tons, while in 1889 the product of Delaware and Maryland together was 29,380 long tons.

Gold.—The crystalline rocks west of Washington are traversed by many bands of gold-bearing quartz, similar to those worked in Virginia and North Carolina. These

veins were carefully described by Mr. S. F. Emmons at the Washington meeting (1890) of the American Institute of Mining Engineers. The occurrence was known many years ago. Since 1885 considerable development work has been done on them in Montgomery county. Sixteen or more claims have been opened. Five of them are equipped with mining machinery and were all worked to some extent in 1890. In 1889 a product of 501 ounces, worth $10,369, and in 1890, 817 ounces, worth $16,885 was incidental to the development work. The "Alton" mine, Henry Watson, manager, is owned in Chicago and is being fitted out with a 20-stamp mill; the "Eagle" (operations suspended for the present) has a 10-stamp mill; the "Harrison," Dr. Walter Kempster, manager, has a 10-stamp mill; the "Irma," Mr. W. T. S. Kirk, manager, has a 10-stamp mill; the "Kirk" Mining and Milling Company has a Wiswell mill with Bumping tables and a concentrator. It is owned in Chicago. The outlook for the camp seems to be fair. It is reached by the Great Falls stage from Washington.

Granite and Gneiss.—Twenty-two quarries in Baltimore, Cecil, and Howard counties were operated in 1889, producing an output valued at $447,489. Of this amount, Baltimore county yielded stone valued at $223,070, Cecil $219,863, and a small amount from Howard county. The granite quarried at Port Deposit has won a wide reputation for the satisfactory stone produced. Throughout the mass of this granite, as it occurs in the quarry, seams occur at intervals from about one-half inch to a number of feet apart, and while they are discernible only by an experienced eye, they are very valuable in the

operations of quarrying and can be opened readily by means of wedges. They frequently reveal perfectly level surfaces ready at once for use in building without the intervention of the stone cutter. The expense of preparing the rock for use in the wall is accordingly reduced. The stone is very hard, takes a beautiful polish, retains its color and can be gotten out in immense blocks—larger indeed than is advisable under ordinary circumstances of handling. It was used in the construction of the piers of the Baltimore and Ohio railroad bridge across the Susquehanna river near Perryville and has given entire satisfaction in this work.

Sandstone.—In 1889 sandstone was produced in Allegany and Frederick counties in small amounts, the total product of the State being valued at only $10,605. The Potomac Red Sandstone Company is operating sandstone quarries on the Potomac river about twenty miles above Washington in Montgomery county. This stone has been quarried since 1884, but for a period of nine years previous to that date there was no production. The stone was originally known as the Seneca red sandstone. It has been used in quite a large number of buildings in Washington city, notably the Smithsonian Institution.

Limestone.—Ordinary limestone from thirty quarries was produced in 1889 to an amount valued at $164,860. The productive counties were the following: Baltimore, $102,350; Frederick, $30,296; Washington, $15,184; and much smaller amounts from Carroll, Allegany and Howard counties. The great bulk of the product was used in the production of lime, which was valued at $148,432. The remainder was used for building and

street work and to some extent as a flux and in bridge and railroad work.

Slate.—The slate product of Maryland comes from what is known as the Peach Bottom-Delta region, in the northern part of Harford county. This region includes four quarries in York county, Pennsylvania, and five in Harford county, Maryland. The product of the Maryland quarries in 1889 was valued at $110,008. One of the chief difficulties met with in quarrying the soft slate of Pennsylvania is the occurrence of so-called "ribbons." These are composed of foreign material and are so hard as to interfere not a little with the ready and economical quarrying of slate. They are entirely wanting in the Peach Bottom-Delta slate, and this makes a great difference in the ease of quarrying, in favor of the product of Maryland.

Marble.—The production of marble proper is limited to Baltimore county at a number of points on the Northern Central railroad. The total value of the output in 1889 was $119,675.

Serpentine.—In Harford county green serpentine is quarried at Broad Creek, a single locality. This stone is an exceedingly valuable one for purposes of interior decoration and furniture tops. The quarry was opened in 1880 and has been in operation ever since.

MANUFACTURERS OF MINERAL PRODUCTS.

Maryland Steel Company.—The works of the Maryland Steel Company, located at Sparrow's Point, on the north bank of the Patapsco, about nine miles from Baltimore,

comprise four large blast furnaces, a Bessemer plant and rail mill, a complete steel ship building plant with machine, boiler and pattern shops and iron foundry adequate to the maintenance of the metallurgical plant, and for the construction of engines and boilers required for the ships built at the Marine Department. In addition to the manufacturing plant there are the necessary wharves for ore and other materials arriving by water, and for the shipping of the products of the works.

The Baltimore & Sparrow's Point railroad, by its connections with the principal trunk lines, gives excellent facilities for shipment by land.

The blast furnaces and the steel plant have been arranged with special reference to the use of hot metal direct from the blast furnaces, and to roll rails direct from the ingots. The Bessemer plant has a capacity of 2,000 tons product per day.

Besides these mills there will be constructed in the future a large open hearth furnace plant, and plate and shape mills for turning out all kinds of material required in the construction of ships, bridges and buildings.

The shipyard commenced operations in February, 1891, and has completed one large steel tug, the "Pennwood," which is now in active service; another is rapidly approaching completion. There are also in the course of construction a side-wheel steamer 210 feet long for the Weems' Line, and a large propeller steamboat 305 feet long for the Old Bay line, for use in the regular passenger and freight service between Baltimore and Norfolk.

Sparrow's Point has at present a resident population of about 3,500. The dwelling houses, which were built by

the Steel Company, are supplied with water from artesian wells, have underground sewerage, and good sanitary regulations. The streets and mills are lighted by electricity. There are churches and schools for white and colored residents, and, among other attractions provided by the Company for its employees, is the beautiful riverside resort known as Pennwood Park.

Baltimore Chrome Works.—The chrome ore contained in the serpentine deposits of Maryland and Southeastern Pennsylvania were known early in the century. Those of Harford County, and shortly after those of Baltimore County, Maryland, were mined by Mr. Isaac Tyson, Jr., as early as 1828. Since that time both the city of Baltimore and the Tyson family have maintained their prestige as producers of chrome ore and its manufactured products. From 1828 to 1845 Mr. Tyson shipped his ore to Glasgow, Scotland, but in the latter year he established his own works in Baltimore. The ore is now obtained from Asia Minor, the Ural Mountains, California, and also, to a small extent, from this neighborhood. The works of the Company are situated on Block street, Baltimore, and at Sea Wall, on the south side of the Patapsco river. They produce the chromates of potash and soda as well as prussiate of potash.

Copper Smelting and Rolling Works.—Occupying a position of prominence among the metal industries of Baltimore is that carried on by the Baltimore Copper Smelting and Rolling Company. For many years Baltimore has been a copper manufacturing centre, and as early as 1815 a copper rolling mill, the direct ancestor of the present company, was started upon the Gunpowder River by

Levi Hollingsworth. In 1845 a copper smelting works was started at Canton and shortly after another at Locust Point. These companies have all been succeeded by the present Baltimore Copper Smelting and Rolling Company, which was organized in 1886 under an amended charter of the old Gunpowder Copper Company. The Browns, McKims, Garretts, Johns Hopkins and other wealthy and prominent citizens have at times been largely interested in these works.

The operations of the Baltimore Copper Smelting and Rolling Company are confined to its Smelting Works at Canton, although its managers and principal owners are largely engaged in mining operations in Arizona and Montana. The Old Dominion Copper Company, controlled and managed by these parties, has extensive mines and works in the Penal Mountains at Globe, Arizona. These mines and works have been steady producers of a very superior grade of copper. During the past year an extensive new smelting plant has been erected at Globe, combining all the modern appliances with the most approved methods. The output of these mines is mostly sold abroad without being refined at Baltimore, and commands always a ready market. These mines and works give constant employment to several hundred men and are managed entirely from Baltimore.

The principal business of the works at Canton is the refining of the Anaconda Matte destined for consumption in this country. This is brought direct from the smelter in Anaconda to the wharf of this company—2,500 miles by rail—in bulk, without transfer, in the form of Matte of 60 per cent. copper, and is here treated in reverber-

atory furnaces, converted into refined ingot copper, and sold for use in every State in the Union. It goes into all forms of brass and bronze castings. In 1891, over 32,000,000 pounds of this refined copper were here turned out, which is known the world over as the "Baltimore Brand." Besides the pure copper, a large quantity of blue vitriol is produced by the extensive and complete Sulphate of Copper Department. Sulphuric acid, for use in this blue vitriol, is also made on the premises.

The Rolling Mill is kept in constant operation, mostly on its specialty, the lighter grades of thin sheets, and the polished surface sheets which have grown in use within a few years for architectural and domestic purposes.

Associated, and nearly connected by tramway, is the Baltimore Electric Refining Company, the most extensive plant of the kind in this country, where the copper product is treated by electrolysis, purifying it and separating its contained precious metals. The copper thus improved is distributed to rolling mills for sheets, and to wire mills for wire. These are employed for all the varied electrical uses, being in demand for their greater conductivity of the electric current.

For all these products the company posesses excellent facilities for distribution—by water at its wharves to all the coast centers, and by the numerous steamship lines to European ports; by rail, over all the roads centering at Baltimore.

The President of the Baltimore Copper Smelting and Rolling Company, is also the Vice-President of the Anaconda Mining Company. This concern is the largest copper producing concern in the world, and its mines at

Butte and its immense reduction works at Anaconda, upon which over seven millions of dollars have been expended, giving employment to over three thousand men, ships its entire product to Baltimore either for treatment at Canton or shipment abroad.

Sulphuric Acid Works.—One of the youngest of Baltimore's industries which depends on the manufacture of an useful product from an ore, is the derivation of sulphuric acid from iron pyrites. The Monumental Chemical Works were constructed at Sea Wall, south of Baltimore, in 1881, for the manufacture of sulphuric acid from Sicilian sulphur. They did not, however, prove successful and were closed before 1888. In that year this plant was purchased by the Sulphur Mines Company of Virginia (Wm. G. Crenshaw, President), and have since been successfully operated for the burning of iron pyrites.

This company was organized in 1882 and work the pyrite vein near Tollersville (on the C. and O. R. R., 56 miles from Richmond), Louisa Co., Va. This vein is from 15 to 80 feet wide and in it have been sunk three shafts to a depth of 300 feet. The product in 1891 was 46,000 tons of ore, and the estimated product for this year is 80,000 tons. The pyrite is superficially oxidized to limonite which was formerly mined. It contains a small per cent. of copper pyrites.

The Monumental Chemical Company uses only about one-sixth of the product of its mines. It has one Spence and one Johnson automatic furnace, and produces about 9,000 tons of chamber acid annually.

The purity of the ore and its freedom from arsenic renders it readily marketable. Ten years ago there was

not a furnace where pyrite could be burned in the United States. Now, however, especially since the increase in the price of native sulphur, it is burned to sulphuric acid in Boston, New York, Cleveland, Philadelphia, Baltimore, Richmond, Charleston, Savannah and other points. The consumption and the production of this ore are rapidly increasing in this country. Some of it is still brought from Europe, but the native deposits should be able to supply our demand.

The Baltimore Shot Tower.—This is situated at the corner of Front and Fayette streets, and has been a landmark in Baltimore for over 50 years. The foundation stone was laid on the 4th of July, 1828, by Charles Carroll of Carrollton, who on the same day laid the foundation stone of the Baltimore and Ohio Railroad. It was built on the site of the first Baptist meeting house erected in the city. The height is 246 feet, base 40 feet in diameter, top 20 feet. The walls are $4\frac{1}{2}$ feet thick at the ground, tapering to 18 inches at the summit. The structure was built from scaffolding on the inside, and about 1,100,100 bricks were used in its construction. Several years ago the interior woodwork of the tower was destroyed by fire, so that, although a fine view is to be had from its top, it is not open to the public. It has not been in operation for several years past.

Brick and Tile.—The superior quality of the clays occurring near Baltimore early gave the city an enviable reputation as a producer of various kinds of brick.

As early as 1812 Col. John Berry commenced the manufacture of fire brick and cement, which has been successfully carried on ever since. The present proprie-

tors of this firm, Messrs. Goldsborough, Bull & Co. (recent successors to J. S. & G. R. Berry), produce all grades and sorts of fire-proof brick and cement at their works, corner of Hamburg and Warner streets. Their capacity is 26,000 bricks daily, and they employ about fifty hands.

The firm of Burns, Russell & Co. commenced the manufacture of brick in Baltimore in 1818, and still continue it. Their product comprises brick of all grades, but the fine pressed brick, for which the Baltimore clay is particularly well adapted, forms their specialty. Their capacity is 15,000,000 brick yearly, giving employment to 250 to 300 men. This pressed brick was used in the construction of the Johns Hopkins Hospital and University buildings. It is also largely used in New York and other cities, and is sent abroad. This firm has recently commenced the manufacture of clay roofing tiles and vitrified paving brick. Office, No. 535 Columbia avenue.

The firm of Pitcher and Creager commenced the manufacture of bricks in 1859. Their works are on the Washington Road, cover fifteen acres, in addition to which they own thirty acres of fire clay. From this they obtain their raw material, and incidentally in its working produce considerable carbonate iron ore. Their capacity is 115,000 brick daily, employing 175 men. They also produce terra-cotta work and roofing tile. They are now supplying the brick for the Belt Line railroad tunnel.

The clays which give the Baltimore brick its good reputation belong in part to the Mesozoic formations (Potomac), and in part to the recent Pleistocene beds (Columbia), which overlie the floor of crystalline rocks in the southern and eastern portions of the city. They are de-

scribed by Tyson, the former state geologist of Maryland, who divides them into three classes.[1] The oldest are the white, gray and red clays, with some beds of sand and gravel, which immediately overlie the crystalline rocks. They are suited for the manufacture of fire-brick and coarse china.

The next class of clays, overlying the first, are the so-called "iron ore clays," which carry the nodular iron carbonate. These are free from sand or gravel, very tough and plastic, and of a lead-grey color. They, however, contain so much iron that they always burn red and are therefore only suited for the production of brick and red ware.

The third class of clays are very much younger than the other two. They occur in small detached areas among and upon the others. They usually burn red and are used for making brick, tile and coarse pottery.

Pottery.[2]—Some of the Baltimore clays, as above stated, are sufficiently fine and free from iron to be suited for the manufacture of the coarser grades of stoneware and pottery. The city, however, produces much finer grades of china and porcelain than could be made of the materials found in her immediate vicinity.

The three requisites for porcelain manufacture are flint (vein quartz) feldspar and a fine clay. All of these occur in excellent quality within the limits of Maryland and the adjoining portions of Pennsylvania and Delaware. Flint is largely quarried in Harford, Carroll and

[1] Second Report of Philip T. Tyson, State Agricultural Chemist. 1862, p. 75.

[2] Information furnished by Mr. David F. Haynes of the Chesapeake Pottery.

Howard counties; a useful soda feldspar is obtained near Rising Sun, Cecil Co., and the best potash feldspar from Brandywine Summit, Delaware Co., Pa. These substances are necessary for a glaze and to give transparency to the ware. The porcelain clays are of two kinds, china and ball clay. The former is a decomposed feldspar (kaolin), not very plastic, but yielding a fine white color. The ball clay is more plastic, but not so white. Almost all the materials used in the Baltimore potteries are derived from the crystalline rocks within a radius of fifteen miles from the point of intersection of Maryland, Delaware and Pennsylvania. A few of the finer china clays come from Cornwall, England. The Maryland coal is also unsurpassed for firing the pottery kilns.

There are in Baltimore five potteries, with twenty or more large kilns, employing about 750 men and women in making and decorating their wares. The Maryland Pottery, at the corner of Fawn and President streets, manufacture chiefly so-called sanitary wares for plumbers' and builders' use.

The Edwin Bennett Pottery has been a landmark at the corner of Central and Canton avenues for nearly forty-five years—it makes a variety of superior wares.

The Chesapeake Pottery, operated by Messrs. Haynes, Bennett & Co., is located on Locust Point, near the pier of the ferry that crosses from the foot of Broadway. Its semi-porcelain wares have attained a high reputation throughout the United States.

Fertilizers.—Baltimore, as shown by the Annual Reports of the division of Mining Statistics of the U. S. Geological Survey, is far in advance of any other city in

the country in the manufacture of fertilizers. Tyson says that Maryland was the pioneer State of the Union in the use of guano and bone manure, which may account for her leadership in this department. Capt. Abel S. Dungan brought the first guano to this country from Peru in 1832, and used it on his farm near Baltimore. The first bone manure used in this country was crushed by Mr. Wm. Trego, of Baltimore, and sold to farmers of Montgomery and Harford Counties.

The State of Maryland furnishes a great amount of burnt lime for agricultural purposes, and it also contains large deposits of marl; but the latter are not at present much used.

The artificial fertilizers manufactured in Baltimore constitute one of its most important industries. It is represented by twenty-seven factories whose aggregate value is $2,000,000. The product of these factories is 450,000 tons, valued at $9,000,000 annually.

The sources of raw material used in this manufacture lie mostly outside the State of Maryland. The phosphate rock from South Carolina is the most important source of phosphoric acid, from 50,000 to 60,000 tons being brought to Baltimore each year. The necessary nitrogen (ammonia) is derived from tankage, ground-crackling, &c., from cities in the west where the great slaughter houses are situated. 25,000 tons of this are annually received valued at $500,000. Other sources of ammonia are dried blood, bones, fish scraps, and bone black whose annual amount is valued at $1,500,000.

In addition to this there are 1600 tons of natural guano brought annually to Baltimore, valued at $200,000.

The Potash used in fertilizers is derived almost entirely from Europe, its most important source being the mineral, *kainite* ($Mg\ SO_4 + KCl + 3aq$), which is shipped just as it is mined at Stassfurt in Germany. Some potassium-chloride and some sulphate is also imported.

MANUFACTURERS OF METALS.

Columbian Iron Works.—In 1870 Messrs. Malster and Donnell formed a co-partnership, for the purpose of building engines, boilers, and machinery. This firm was dissolved in 1872 and W. T. Malster became sole proprietor of the plant. He shortly after leased an additional and larger yard at Canton, and the two yards were known from that date as the *Columbian Iron Works.* At the Canton yard, Mr. Malster built the powerful ice-boat "F. C. Latrobe" and the steamers "Enoch Pratt" and "Canton," also the steam yacht "Bretagne" for Mr. Henry Say of Paris. The latter vessel was, at the time of her completion, the largest steam yacht in the world. In addition to the building of the above noted vessels, the most important work done at this yard was the removal and overhauling of the U. S. S. "Tallapoosa," and the building of the six hundred foot iron bridge over Jones' Falls on north Calvert st. In addition to the work done at the Canton annex the following vessels were built at the Ann street yard: light house steamers "Laurel" and "Arbutus," steamers "Camille," "Royal Arch," and the powerful tug "Alex. Jones;" this latter vessel had the distinction of having the first compound engines that were built in the city of Baltimore. Mr.

Malster continued at the Ann street and Canton yards until 1880, when it was again found necessary to seek more commodius quarters for the growing business of the Company. The great advantage of a dry dock induced Mr. Malster to move across the basin to the present site at Locust Point, where he leased the 450 feet dry dock for a term of ten years.

In Feb. 1884, the Columbian Iron Works and Dry Dock Co. was incorporated. The first work taken in hand was the building of the engines and boilers of the steamers "Cumberland" and "Nansemond." In July 1884, the Company rebuilt the steamers "B. S. Ford" and "Caroline Miller." In 1886 the Company built the iron ornamental bridge across Jones' Falls at the Union Station. In 1887–88 were built the steam ferry boats "Robert Garrett" and "Erastus Wiman" for the New York and Staten Island Ferry Co., and the new ice boat "Annapolis." The U. S. Gunboat "Petrel" was completed in 1889. In 1890 the oil tank steamer "Maverick" was completed, being the first vessel of this kind built on this side of the Atlantic. The keels of the cruisers "Montgomery" and "Detroit" were laid in March 1890. The Detroit was launched October 28, 1891, and the Montgomery Dec. 5th, of the same year. These two vessels are now within a few months of completion. The Columbian Iron Works and Dry Dock Company employs an average force of about six hundred men. The property is located upon a tract of land adjoining Fort McHenry, having a water frontage of about 500 feet, and contains about fifteen acres. The dry dock is the largest and best equipped in the city.

The brass foundry has turned out some difficult castings in the past year, notably the castings of the condensers for the engines of the cruisers Montgomery and Detroit, and the cylinders of the pumps of the U. S. armored battle-ship "Maine."

The McShane Bell Foundry.—These works are situated on North street, opposite Calvert Station, and form one of the largest establishments in the world engaged in the manufacture of church bells, chimes and peals of bells. Among the places in which these bells may be heard are: Foochow and Shanghai, China; Mhow, Burmah; Bareilly and Mossoori, India; Tokio, Japan; Monrovia and Liberia, Africa; Salonica, Turkey; Alexandria, Egypt; Brazil, Bogota, Guayaquil, South America; Cuba, Jamaica; Birmingham, England; Varna, Bulgaria; Mexico and throughout Canada and the British Provinces and in every State in the Union. In 1878 one of the McShane church bells was sent to the Paris Exposition, and was selected by the authorities to announce each day the opening of the Exposition, and also received a medal and diploma. The Centennial chimes, exhibited at the Philadelphia Exposition, were afterward purchased by Mrs. A. T. Stewart for the cathedral at Garden City, L. I.

In addition to the bell foundry there are extensive iron and brass foundries, copper boiler and bath-tub works, blacksmith and machine shops and brass finishing shops. This plant covers about six acres and gives employment to nearly 1,000 persons.

Bartlett, Hayward & Co. are among the largest manufacturers of iron in Baltimore. Their business, which

was started by Mr. Jonas H. Hayward for the production of stoves in 1844, has been steadily enlarged and now embraces the manufacture of ornamental and all other iron work for architectural purposes, the preparation of all materials for water and steam heating, and the construction of complete plants for making illuminating gas.

This firm furnished the heating apparatus for the Johns Hopkins Hospital (see p. 38) and the City Hall of Baltimore; also those in the Treasury, State War and Navy building, Post Office and new Library at Washington. They have erected, wholly or in part, gas-plants in New York, Brooklyn, St. Paul, Rochester, Newark and other cities.

The works of the firm cover a large area on Pratt, Scott and McHenry streets. They employ from 800 to 1,200 men, according to their contracts on hand.

Machinery.—The Detrick & Harvey Machine Company, manufacturers of machine tools and special machinery, succeeded the firm of Detrick & Harvey.

Special attention for a number of years has been devoted to the development and improvement of the open side planer, a useful innovation in planing machines, the patents of which the company controls.

The open side planer differs from the ordinary planer, in that it has but one post, the open side giving this tool an extremely wide range, and a great advantage over all other planing machines. It is specially adapted to work large and irregular shaped castings, which will not pass between the posts of a two-post planer of the same size, but which can readily be handled on this tool,

the outer end of work being supported by a supplemental rolling table.

This firm has also built a variety of tools for the manufacture of guns from 10 to 12 calibre, notably hoop and jacket lathes, threading and slotting machines, etc. It also produces various machines for the treatment and manipulation of tobacco, including tobacco spraying, cigar and cigarette machines.

The Robert Poole & Son Company was evolved from the old firm of Poole & Hunt, founded in 1843.

Their works are situated in the northwestern part of the city of Baltimore, in the quarter known as Woodberry.

The workshops are substantially built and cover about ten acres of ground, the Northern Central railroad passing directly through the premises. Among its facilities is a recently added two-story brick extension to the machine shop, and an erecting-shop 100 feet wide by 208 feet long. This shop is equipped with a 30-ton travelling crane, 60 feet span, with a vertical height of 50 feet. A boring and turning mill capable of producing a turning 25 feet in diameter, is one of the largest, if not the largest, tool of its kind in the world. A lathe capable of finishing wheels 54 feet in diameter with 10 foot face, and a planer over 12 feet between housings, 30 feet long and 12 feet high were also designed and built by the Company.

This Company were pioneers in the manufacture of the loom for weaving cotton duck, to which to-day Baltimore largely owes her reputation for the superiority of her cotton products. They developed the Leffel turbine water-wheel, and were also pioneers in the manufacture of cable

railway machinery, having furnished the first plant for the Chicago railway Co. in 1881, soon after the successful demonstration of the practicability of rope traction at San Francisco, Cal. Besides being actively engaged in the production of power-transmission machinery, the Company have designed and built a most extensive plant for the manufacture of machine-molded gearing, and they possess facilities for producing gears from one foot to 30 feet in diameter, weighing 100,000 pounds, and for the manufacture of pulleys of all sizes up to 50 feet in diameter. They employ from 400 to 500 skilled workmen, and are extensively engaged in the manufacture of all kinds of special machinery.

The Warfield Manufacturing Company was incorporated 1883 and occupies the premises 336, 338, 340 and 342 North street.

Aside from the manufacture of complete plants for the generation and transmission of steam power, this Company builds automatic cut-off, high speed steam engines, which are used extensively in driving dynamos for electric lighting.

This Company is now making a specialty of electric lighting plants, and is the only firm in the South which owns and builds its own automatic steam engines, and furnishes the complete machinery for either an isolated plant or central station equipment.

This Company furnished the contractors for the tunnel of the Baltimore Belt Line, their entire lighting equipment.

Elevators.—Snowden & Cowman commenced the manufacture of elevators and hoisting machinery in

1875. Their specialty is elevators. In 1880 they found it necessary to increase their facilities for manufacturing by the erection of a large iron foundry and machine shop on West, near Leadenhall street. They manufacture every part of their elevators (except wire ropes) at these works.

Their pattern shop, wood workers and cabinet makers are all under the same roof, and under the direct supervision of the senior partner. They employ about fifty mechanics.

Safes.—The Miller Safe and Iron Works is an industry started some thirty-five years ago by its present proprietor, Mr. L. H. Miller. Besides the manufacture of portable safes, building iron-work, vaults, doors, etc., enters largely into their production. This firm has filled contracts given by the U. S. Government, including vaults of the U. S. Treasury buildings, Washington; the Baltimore Post Office, and many such buildings in other states; also safes for the U. S. Consulates in foreign countries.

The factory is located in South Baltimore and occupies a square, bounded by Fremont, Warner, Henrietta and Claret streets, with some twenty dwellings suitable for the workingmen. The number of men employed varies from 75 to 100 according to the contracts on hand.

THE GEOLOGY OF BALTIMORE AND ITS VICINITY.

PART I.

GEOLOGY OF THE CRYSTALLINE ROCKS.

By Professor GEORGE H. WILLIAMS
of the Johns Hopkins University.

INTRODUCTION.

For the adequate comprehension of the crystalline rocks occurring within the limits of the U. S. Geological Survey atlas-sheet "*Baltimore,*" which accompanies this text, some broader knowledge is necessary of the geology of that great Piedmont belt, of which it is a fragment. A brief general characterization of this province must therefore precede the more detailed descriptions of the local geology about Baltimore.

Along the eastern flank of the Appalachian and Green Mountain uplifts there is a belt of highly crystalline or semi-crystalline rocks which extends from Alabama to Maine, and even farther north. This zone attains its maximum width (300 miles or more) in the Carolinas. Toward the north it narrows and is nearly buried beneath

the Trias in New Jersey; beyond New York, however, it suddenly broadens so as to embrace the larger part of New England. Within this whole province the rocks are so crystalline as to make fossils rare, while their structure presents some of the most puzzling problems in American geology. Many theories have obtained regarding the age and origin of the strata, but it is only within very recent years that elaborate and detailed work has begun to satisfactorily solve the mystery. In New England the entire sequence of Palaeozoic sediments is found in more or less completely metamorphosed form, with occasional areas of more ancient crystalline rocks (Archaean) protruding through them, while they are cut by a variety of eruptive masses.

South of New York the crystalline belt acquires a more homogeneous character, both structurally and topographically, which fact, together with its position at the eastern foot of the Appalachian system, has occasioned its designation as the Piedmont Plateau.

PHYSIOGRAPHY OF THE PIEDMONT PLATEAU IN MARYLAND.[1]

Topographically the Piedmont plateau may be considered to begin in Maryland at the eastern base of Catoctin mountain, a sharply defined ridge of nearly uniform height (1500 ft.) extending from Point of Rocks on the Potomac, northward to the Pennsylvania line just

[1] See "The Petrography and Structure of the Piedmont Plateau in Maryland," by George H. Williams. *Bull. Geol. Soc. Am.*, vol. 2, pp. 301–322 and map, 1891.

west of Emmitsburg. East of the Catoctin ridge nearly three thousand square miles of surface are exposed within the State before the overlap of clays and gravels belonging to the formations of the Coastal Plain are encountered. Geologically, however, the western boundary of the Piedmont belt in Maryland must be drawn considerably farther east, if, as is usual, we wish to confine this term to rocks of undetermined age. At the base of Catoctin stretches a broad transgression of Newark red sandstone, from beneath whose eastern border emerge the upturned edges of the Trenton-Chazy[1] limestone.

We may roughly outline the Piedmont region proper in Maryland as a trapezium, bounded on the north by the State line, on the east by the Baltimore and Ohio railroad from Wilmington to Washington, on the south by the Potomac, and on the west by the Monocacy river. The surface of this area is nearly level, but it slopes very gently from a median water-shed, known as Parr's ridge. The region has been so recently elevated that its streams are still excavating narrow precipitous channels.

The rocks composing the Maryland portion of the Piedmont plateau are divisible into two distinct classes. The members of one of these classes are all completely crystalline, and, whatever was their origin, they now retain no certain evidence of clastic structure. These rocks are confined to the *eastern* portion of the plateau province and disappear beneath the overlying deposits of unconsolidated sand, gravel and clay, which compose the Coastal plain.

[1] Determined in June, 1890, by Mr. C. R. Keyes, of the Johns Hopkins University.

The second class of Piedmont rocks are semi-crystalline, and, while they have been subjected to a certain amount of metamorphism and alteration, they still plainly show that they were once sediments of an ordinary type. While as yet no fossils have been found in them, they are not more altered than similar formations which in other localities have yielded fossils, so that there is every reason to suppose that their age will subsequently be definitely determined on palaeontological evidence. While these semi-crystalline rocks are principally confined to the western half of the Plateau region, there are isolated areas of them within the holocrystalline belt, which appear to be much younger, but which have been protected from removal by being folded in among the gneisses. The line separating these two divisions of the Piedmont plateau, which we shall hereafter designate as the semi-crystalline (western) and holocrystalline (eastern) areas, is not coincident with the crest of Parr's ridge, but lies on its eastern flank. Commencing in the south near Great Falls on the Potomac, it passes slightly west of Rockville and of Hood's Mills, then through Westminster on the Western Maryland railroad, and thence by a north-northeastward course to the Pennsylvania line. Further eastward there is a large area of the semi-crystalline schists in Harford county, surrounding the Peach Bottom and Delta roofing slates. These appear to be infolded in the gneisses, and are probably connected with the area near Finksburg by a narrow tongue passing the Northern Central railroad at Whitehall. A similar infold of slates also occurs further southward, near Occoquan and Dumfries in Virginia. The lines of demarcation between these

infolded areas and the surrounding gneisses are not less sharp than those separating the main crystalline and semi-crystalline areas themselves.

STRUCTURE OF THE PIEDMONT PLATEAU IN MARYLAND AND ITS INTERPRETATION.

The structure of this region has been worked out along three sections laid across it from west to east, each about fifty miles in length. They follow in the main the three lines of railroad which traverse the region (the Western Maryland, the Baltimore and Ohio main stem, and Baltimore and Ohio Metropolitan branch), although the northernmost section leaves the Western Maryland railroad where it turns southward, at Finksburg, and is continued eastward to Glencoe, a point on the Northern Central railroad directly north of Baltimore.

The most striking feature of these sections is their radiating or fan-like structure, and the fact that the vertical strata forming the axis of this fan follow a direction neither parallel to, nor coincident with the boundary between the crystalline and semi-crystalline rocks. These two lines start from the same point on the Potomac (Great Falls), but diverge more and more toward the north. The fan, therefore, while its axis is throughout composed of semi-crystalline rocks, has its western flank made up of the least crystalline, and its eastern flank of the most crystalline portion of the Piedmont region.

If the sections be followed from west to east, the oldest formation of known age—the Frederick limestone—emerges from beneath the transgression of Triassic

(Newark) sandstone as a series of considerably folded beds, which are succeeded on the east and apparently overlain by carbonaceous and hardly altered shales. These are like those which occupy a similar position above the same limestone farther westward, and may represent the Hudson River horizon. Still beyond, there follow with the same easterly dip, the thick beds of sandstone which compose Sugarloaf mountain. These thin out toward the north to a few insignificant sandstone patches, while toward the south they soon disappear beneath the Newark transgression. The Sugarloaf sandstone passes, on its eastern side, upward by a gradual transition through shaly layers into sandy slates, and these again into the succession of sericite and chlorite schists, which compose the mass of the semi-crystalline area. Beneath the sandstone the shales are more disturbed, and, as there is here no such transition, this surface represents a fault or thrust.[1]

The main body of semi-crystalline rocks in the Piedmont region is slate and soft schists, and, north of the Baltimore and Ohio main stem, limestone bands, which preserve a constant north to north-northeast strike. The dip of these rocks is always toward the east as far as a line (the axis of the fan) which runs nearly north from

[1] The course of the great Triassic trap dike, which extends from Emmitsburg entirely across the state is worth noticing in this connection. It is nearly parallel to the synclinal axis of the Piedmont plateau, and may represent a preëxisting line of weakness in the crust. Its course runs along the western flank of Sugarloaf. Strong corroborative evidence of the thrust nature of this mountain is afforded by a recently discovered band of intensely crumpled, faulted aud dynamically metamorphosed slate, which occurs immediately beneath the western edge of the sandstone.

Great Falls, where they become vertical. Toward this axis the dip becomes constantly steeper and steeper, yet the character of the rocks is but little changed, save that they become gradually more shattered and crinkled.

After passing the vertical axis, the same structure is observed on the east as on the west, but in an inverse order. The dip of the strata turns gradually toward the west, becoming less and less steep as we proceed from the axis towards the Coastal plain. All the westerly dipping strata in the southern part of the Piedmont region, where the axis is nearly coincident with the boundary between the eastern and western areas, belong to the more crystalline rocks. Further northward, however, there is a considerable expanse of the semi-crystalline schists on the eastern side of the axis. These do not differ in any way from those on the western side, except in the direction of their dip. The same *general* strike and dip are also unmistakably displayed within the completely crystalline rocks forming the eastern area; but here there is far less uniformity in structure than is to be found among the semi-crystalline strata. Many disturbances attendant upon successive eruptions, dislocations and foldings, all anterior to the movement which gave the schists and slates their present position, have left their record in a much more irregular distribution and a much more complex structure; a fact which, we shall see beyond, is of great significance in the interpretation of the sections here described.

In spite of the apparent constancy of their dip, the horizontal extent of the semi-crystalline rocks cannot be taken as any measure of their real thickness. The cleavage has much obscured the bedding, and the succession must

be many times repeated by sharp folds and faults. Such dislocations are now, however, almost entirely obscured by (1) the perfect and uniform cleavage, (2) the even surface to which they have all been worn down, and (3) the extensive superficial decay to which they have been subjected. As we approach their eastern boundary the semi-crystalline rocks exhibit the effects of more intense dynamic action. Along the axis, where they stand vertical, and also east of it, they are much broken, crinkled, and corrugated. Still all the disturbance and alteration observed in the semi-crystalline schists may be readily accounted for by a *single* earth-movement; *i. e.*, by a force acting for a long time in a single direction.

Throughout all of the Piedmont area in Maryland east of the axis there is the general tendency to westerly dip above alluded to, and yet this feature is so much less constant in the holocrystalline than in the semi-crystalline rocks that it indicates a structure added to others which it has only partially obliterated. The very irregular areas occupied by the different rocks, the abrupt changes in trend and structure, and the much more intense alteration of the sedimentary beds, all bear witness to successive periods of compression and disturbance to which the western schists could never have been subjected. No action of a force from a *single* direction can be made to account for the implicated structure of the eastern rocks, as it can for those further west. These must have been wrenched, folded and faulted at *different* times, and in this respect the two portions of the Piedmont region in Maryland present one of their strongest contrasts.

To account for the structure of the Piedmont plateau in

Maryland as outlined in the preceding paragraphs, three hypotheses have successively suggested themselves. Two of these have, however, been already found to be more or less at variance with facts observed; and although it cannot of course be asserted that, as the work of mapping in detail progresses, the third hypothesis in its present form will be found to stand the final test, it may be provisionally accepted as best in accord with our knowledge of the facts at this time.

These three hypotheses are:

1. That the rocks of both the eastern and western areas are of the same age, and that they have been bent into a broad synclinal whose flanks are so sharply folded, faulted and thrust as to simulate the fan-structure observed in high mountain chains; and that the eastern flank of this synclinal or fan was much more highly metamorphosed than the western both by more intense dynamic action and by intrusion of a great amount of eruptive material.

2. That the more highly crystalline, eastern area is greatly older than the western schists, and served as a rigid buttress against which these were thrust and folded.

3. That the eastern area is composed of rocks far more ancient than the western, which extend out under these, forming the floor upon which they were deposited; and that, although already much folded and metamorphosed, this crystalline floor underwent at least one more folding after the schists had been laid down, carrying these with it and involving them in a considerable, but not an extreme amount of disturbance and metamorphism.

The first of these hypotheses, which was held by

Tyson, is naturally suggested by the close correspondence of sedimentary rock types in the western and eastern areas, and also by the structure, in making a section across the region. A sufficient cause of the increased metamorphism and disturbance on the east was sought in the vast amount of eruptive rocks, which are absent from the western area. As conclusive, however, against the identity of age for the semi-crystalline and holocrystalline rocks we may summarize the following points:

a. The structure is not really a synclinal, but a fan-like divergence of dip from a central vertical axis, such as could not be produced by any synclinal bending in a continuous series of similar beds.

b. Any cause altering any part of an original series more than another would not make an *abrupt* contact, such as we find between the semi-crystalline and highly crystalline rocks of Maryland, but a gradual transition.

c. Any cause altering one flank of a synclinal more than the other would make the contact between the two kinds of rock and the axis of the synclinal coincide, as is *not* the case in Maryland.

d. The eruptive rocks of the eastern area are found in many places in close proximity to the slates or schists, without having effected their alteration; hence they are either not the cause of metamorphism, or they are themselves older than the semi-crystalline rocks; and, moreever, the sudden disappearance of the abundant eruptive rocks at the edge of the western area is itself a strong reason for supposing that it is of later age.

e. We cannot suppose that excessive dynamic action was the cause of the metamorphism, because where we

should expect the folding force to have acted equally we find the hardest rocks (eruptives) much more altered, foliated and disturbed than the soft argillites.

In face of the facts, we seem, therefore, obliged to admit that the boundary line between the semi-crystalline and holocrystalline portions of the Maryland Piedmont area represents a great time-break.

The second and third of the above-mentioned hypotheses assume the difference in age of the western schists and eastern gneisses and eruptives. The second hypothesis (*i. e.*, that there was a passively resistant buttress of crystalline rock) is, however, as little in accord with the facts as the first, since it cannot possibly be reconciled either with the conformity in dip and strike of the schists and gneisses along their contact, or with the infolding of the slates and schists *in* the gneisses, as may be seen in the Peach Bottom-Delta area and at Occoquan, Virginia.

We are therefore driven to the third hypothesis as the most reasonable explanation of the facts. This supposes an ancient and crystalline floor, upon which were deposited the sediments now forming the western slates, sandstones, limestones and schists. At the time of the Appalachian uplift this crystalline floor underwent a final folding, which involved the overlying sediments, and thereby folded, faulted, cleaved and altered them. This hypothesis seems to account for the difference between the rocks of the two areas and for the abruptness of their contact, while at the same time it explains the conformity along this contact, and the fact that this boundary and the axis of the synclinal or fan are not coincident. We may therefore accept it as the most probable one, unless

future exploration shall render some modification of it necessary.

GEOLOGY OF THE EASTERN OR HOLOCRYSTALLINE PORTION OF THE PIEDMONT PLATEAU IN MARYLAND.

The area included within the map (U. S. Geological Survey atlas-sheet "Baltimore"), which it is the particular object of this communication to describe, lies entirely within the eastern or holocrystalline division of the Piedmont plateau. The various rock formations composing it cross Maryland from the southeast corner of Pennsylvania and the north end of Delaware in a general southwest direction. Their course is, however, not a straight one through the state, but forms a double curve, whose south side is convex on the east and concave on the west. This curve corresponds to the great westerly bend in the course of the triassic sandstone and folded Palaeozoic beds of eastern Pennsylvania. It is, of course, much less distinct in the highly crystalline rocks of the eastern Piedmont region, but that its presence can be traced at all amid the varied and complex structures of these very ancient rocks, is welcome evidence that at least the final impress was imparted to their strike by the great Appalachian folding. The convex or eastern branch of this curve may be most distinctly traced on our map in the belts of marble north of the city, which, near Towson, turn from a southwest direction to a trend directly west through the Green Spring valley. Beyond

the western limits of the map these same marble belts turn again to the south-southwest, as do all the other rocks with which they are associated, and this course they hold into Virginia.

That such structural features of the eastern Piedmont region as conform to the Appalachian folding are not, however, the only ones which belong to these rocks, but that their present metamorphism and complexity must be accounted for by assuming that they have been subjected to several periods of successive disturbance, has been already emphasized (see above p. 84).

The rocks composing the holocrystalline portion of the Piedmont plateau in Maryland are petrographically divisible into six distinct types. Three of these are of undoubtedly eruptive origin, and may be designated, according to their chemical and mineralogical composition, as *gabbro, peridotite* or *pyroxenite,* and *granite.* The three remaining types—*gneiss, marble,* and *quartz-schist*—are completely crystalline, and therefore exhibit no certain traces of clastic structure. The position to be assigned to this complex in the geological column is a matter deserving careful consideration, although data for a perfectly satisfactory conclusion are not yet at hand. It is believed that these rocks are demonstrably older than the altered lower Palaeozoics of the western Piedmont region (see above pp. 82 and 86); and yet that they themselves contain in their chemical composition, stratigraphy and in the presence of certain obscure conglomeratic beds near Washington, evidence of a clastic origin. For these reasons, as an expression of our present knowledge, the complex is provisionally assigned on the accompanying map to the

Algonkian horizon.[1] It is not, however, impossible that future work in this and related regions north and south may result in referring the Baltimore crystallines to the Archaean, the Algonkian being absent in Maryland.

The prevailing rock over the entire holocrystalline area is the gneiss. It enters the state from the north in a very wide band, completely surrounding the Delta-Peach Bottom slate area, but its breadth rapidly contracts toward the Potomac. The remarkably irregular forms of the marble areas, which are intercalated in the gneiss complex, show how intricate the stratigraphy of the latter really is. Much of its apparent simplicity is due to the obliteration of its true bedding through secondary foliation.

The oldest, as well as the most extensive of the three eruptive rocks which so abundantly intrude the gneiss complex is the gabbro. Of this there are three main areas in Maryland: the Stony forest area of Harford and Cecil counties; the great belt or sheet which extends from north of Conowingo on the Susquehanna river, in a south-southwest direction to Baltimore city; and the irregular intrusive area which is mainly developed to the west of Baltimore, but extends thence as far south as Laurel.

The next eruptive rocks in point of age are the basic magnesian silicates, peridotite or pyroxenite, and their alteration products, serpentine and steatite. These are intimately associated with the gabbros, but occur most abundantly toward the western edge of the crystalline

[1] See C. R. Van Hise: "Correllation Essay on the Archaean and Algonkian Formations." *Bulletin of the U. S. Geological Survey*, No. 87, (in press).

region. They do not occur in so large masses as the other eruptive rocks, but occupy numerous small areas which it would be useless to enumerate.

The youngest intrusive rocks which break through the gneiss are the granites. They form large masses at Port Deposit and Havre de Grace on the Susquehanna river; also near Joppa and to the north of Towson; at Woodstock and Sykesville; at, and south of Ellicott City; and at several localities near Washington. The granites are so like the surrounding gneisses in chemical, as well as in mineralogical composition, that where they have been greatly foliated through dynamic action, it becomes a matter of no small difficulty to distinguish them.

Detailed descriptions of these types of crystalline rocks will only be attempted in so far as they fall within the limits of the map of Baltimore and its vicinity here under consideration.

PARTICULAR DESCRIPTION OF THE GEOLOGY NEAR BALTIMORE.

The unit of area selected for the description of the geology about Baltimore is the U. S. Geological Survey atlas-sheet. This covers an area of about 190 square miles, or one-sixteenth of a square degree between parallels 39°15′ and 39°30′ N. Lat.; and meridians 76°30′ and 76°45′ W. Lon. The scale of this map is 1 : 62,500 or nearly one mile to the inch.

Geologically, the Baltimore sheet is a small fragment of the above described eastern, or holocrystalline portion

of the Piedmont plateau, with its overlying Coastal plain formations. The very irregular boundary line between the older rocks and the unconsolidated deposits crosses the sheet from northeast to southwest. The details of the complicated and varied geology of this small region can only be understood in connection with the foregoing description of the larger provinces to which it belongs.

THE STRATIFIED COMPLEX.

All six types of crystalline rocks which have been enumerated as composing the entire eastern Piedmont belt in Maryland are well represented within the limits of the Baltimore atlas-sheet. Those three types which possess a conformable sequence and a banded structure, analogous to stratification, will first be considered under the head of gneiss, marble (dolomite), and quartz-schist.

The Gneiss.

Petrographical Character.—Of all the rocks occurring within the limits of the Baltimore sheet, those which may be classified as gneiss are the most widely distributed and the most varied in character.

They occupy most of the eastern and northern portions of the crystalline area, but are largely replaced by eruptive rocks in the western portion.

The Baltimore gneisses embrace a great variety of types, which range from granitoid aggregates of feldspar and quartz, on the one hand, to nearly pure mica or hornblende schists on the other. All of these also show con-

siderable structural variation in their coarseness of grain, the perfection of their parallel arrangement, etc.

The gneiss is sometimes quite constant in character for considerable distances, but more usually it consists of a succession of differently constituted layers.

In spite of a frequent persistence of strike and dip, the gneiss everywhere shows that it has been subjected to intense and repeated dynamic action. This is apparent in the large features of its structure, in its greatly crumpled, gnarled and twisted character, and in the profound metamorphism, amounting to almost complete recrystallization, which has gone on within it. No certain traces of clastic origin have ever been detected in the Baltimore gneisses, although their sedimentary character may be inferred from their rapid alternations of beds of different composition, and from the nature of other rocks intercalated in them, like the marbles and quartz-schists. In the continuation of the same rocks southward to the neighborhood of Washington evidences of a conglomeratic character have also been observed.

The color of the more massive gneisses varies from white to a dark grey or blue. The more micaceous and hornblendic varieties are dark brown or green. The mineral composition and structure is quite normal for gneisses. Epidote is a frequent constituent of the more acid types, while the more micaceous layers are frequently rich in such characteristic metamorphic minerals as garnet, fibrolite, kyanite and staurolite. The hornblende gneisses contain an abundance of epidote, sphene and rutile. The quartz and feldspar not infrequently exhibit the effects of pressure under the microscope, and when

these are not visible, it is because the constituents are products of new crystallization.

The most characteristic sections of the Baltimore gneisses are exposed along the Gunpowder river, especially above Loch Raven; along Herring's Run above Hall Spring; on Jones' Falls between Baltimore and Woodberry; and on Gwynn's Falls below Wetheredville. The freshest, and, in many respects, the most characteristic material is, however, to be found about the mouths of the numerous shafts to the water conduit from Montebello to Loch Raven.[1] With the exception of a little marble near Loch Raven, the gneiss is the only rock passed through by this tunnel. The material which was brought to the surface is particularly instructive in showing the effects of profound folding, faulting and crushing.

Structure.—The geological structure of the crystalline rocks near Baltimore is particularly involved and difficult. The original stratigraphy has been largely obscured or obliterated by the development of secondary foliation during successive periods of disturbance and metamorphism. An attempt has been made to represent on the first of the two geological maps the general strike of the gneisses by the direction of the heavy green hacheur lines. It will be noted that the main trend of the rocks on the eastern portion of the sheet is NNE–SSW; but that through its northwestern portion the trend alters to E–W. This important change in strike commences in the neighborhood of Towson, and causes all of the foliated rocks

[1] See description of the Baltimore water-works, p. 48.

to conform to the northern edge of the great mass of eruptive gabbro west of Baltimore. This trend, however, also corresponds to a similar structural feature farther north, as has been explained above (p. 88); and it is difficult to say how far the intrusion of the gabbro was a cause, and how far an effect of the westward bending of the strike west of Towson. The latter is, however, rendered the more probable from the fact that this divergence from the main direction does not soon die out toward the north, but may be traced through all the crystallines to the Pennsylvania line.

Another striking and unexpected feature exhibited by the gneisses is that their foliation follows the northeastern boundary of the gabbro mass. This gives the gneisses a southeast trend, and causes them to join those with a normal northeast strike in a sharp V, instead of blending with them in a gentle curve, as at Towson. Such a conformity of the strike in gneiss to the boundaries of eruptive masses which it surrounds has frequently been observed. In this case, it is well shown by the direction of the band of quartz-schist, which extends from near Mt. Washington to Montebello, but unfortunately the details of structure are here obscured by the overlying Coastal plain deposits.

The gneiss is not only conformable to, but it passes insensibly into the quartz-schist. It is also in general conformable to the marble where the two are in contact. In certain notable instances this is, however, not the case, but the strikes of the two rocks meet at a high angle, indicating great dislocation. Such cases may be seen north of Lake Roland, south of Brooklandville, on

the northern edge of the Mine Bank valley and along the southern edge of the gneiss plateau east of Cockeysville. Such unconformities indicate that the complex structure of this region has been produced, not merely by folding and crumpling of the strata, but by faulting and thrusting on so large a scale and at so many periods as to render the deciphering of the successive events difficult, if not impossible. The very inadequate exposures over large areas of the gneiss doubtless hide other important thrusts and faults, but a proof that such exist may be found in the vast amount of vein quartz, which everywhere appears at the surface, as the gneiss itself decomposes into soil.

Alteration.—Superficial exposures of the gneiss are very rarely fresh. This widespread decay extends also for a considerable distance below the surface, at least in an incipient form, as may be seen from the very rapid disintegration, in road and railway cuttings, of rock hard enough to be blasted out. Such extensive alteration is a great obstacle to the deciphering of the real structure of the gneiss, since it obscures the petrographical character, and also renders unreliable the dip and strike even in exposures of considerable size.

The exact amount of alteration differs with the mineral composition, those layers which are most massive and feldspathic being, as a rule, the most resistant. Planes where there has been movement and consequent crushing are also more liable to decomposition. This is well seen in one of the best preserved and massive exposures of the gneiss anywhere near Baltimore, viz., in the quarries on Jones' Falls, opposite Druid Hill Park. The rock is

here largely quarried as a building or paving stone; and yet certain of its layers are much altered. In many cases this has resulted in the production of new minerals which have rendered this a well-known locality for specimens. Among the species which have been produced in this way may be mentioned: The zeolites, stilbite, chabazite (haydenite), harmotome, heulandite (beaumontite), laumontite; calcite, siderite, barite, pyrite, epidote, halloysite, chlorite and quartz.

Uses.—The Baltimore gneiss was formerly used as a building stone, and such important structures as the cathedral, jail and courthouse of Baltimore are constructed of it. The irregular and mottled structure of the gneiss, however, ill-suited it for this purpose, and other more agreeable materials have replaced it as a building stone. It is still very extensively employed as a foundation and paving stone. For such purposes it is quarried on Jones Falls (so-called "Falls road blue-stone") and at other localities on Gwynn's Falls and Herring's Run.

The Marble (Dolomite).

Petrographical Character.—This rock is designated on the map as the Cockeysville marble, because it is extensively quarried at this place. It is throughout its entire extent on the Baltimore sheet a highly crystalline dolomite with all of its original impurities separated in the form of well defined minerals. It has now lost all evidence of clastic origin, except the frequent arrangement of its accessory constituents in parallel layers, which probably represents its former bedding.

The variations in the dolomite are dependent on differences in its chemical composition, in the coarseness of its grain and in the nature and amount of its accessory constituents.

The proportion of magnesian carbonate in the dolomite is variable, as is shown by different analyses. Its average is perhaps about 40 per cent. A complete analysis of a specimen from Cockeysville yielded to Mr. J. E. Whitfield, chemist of the U. S. Geological Survey, the following result (see *Bull. U. S. G. S.*, No. 60, p. 159):

SiO_2 . . .	.44
Al_2O_3 . . .	1.22
FeO . . .	trace
CaO . . .	30.73
MgO . . .	20.87
CO_2 . . .	45.85
Ignition . .	1.22
	100.33

The coarseness of grain of the dolomite varies considerably, even within short distances. The very coarse varieties, known to the quarrymen as "alum stone," are useless for building material, but are extensively burned for lime at Texas, Baltimore county. The marbles of the eastern portion of the Piedmont region are, however, throughout much coarser than the fine, compact crystalline limestones of the western or semi-crystalline area.

Another striking contrast between the marbles of these two regions is that, while the latter contain their impuri-

ties in the form of thin argillaceous bands, the former have theirs represented by layers of perfectly crystallized silicates. Of these by far the most important is the dark brown mica, phlogopite. This is frequently very abundant, and often causes the dolomite to strongly resemble a gneiss in appearance. Other accessory constituents of the dolomite are tremolite, white pyroxene, green muscovite, brown and black tourmaline, scapolite, quartz, pyrite and rutile.

Structure.—The Baltimore marbles have been so intensely folded, and their recrystallization has been so complete, that the working out of the details of their structure is well-nigh impossible. The general lines of their structure must be inferred from their areal distribution and their relations to the adjoining gneisses. But even their areal distribution is so anomalous and irregular as to render any explanation of their structure unsatisfactory. It is clear that it is to be accounted for not by folding alone, but by folding accompanied by thrusts and faults at several successive periods. The usual occurrence of the quartz-schist on only one side of the limestone belts is good evidence of thrusting, as may be seen in the Mine Bank valley, the Dulaney valley east of the Hampton estate, and in the Green Spring valley. North of Lake Roland a huge block of marble seems to have been forced southward, abruptly cutting off the high ridge of quartz-schist, and itself dividing into an eastern and western arm at the point of the gneiss ridge which rises west of Ruxton.

This area of the dolomite is faulted against the gneiss both on its eastern and western sides, and forms the fertile

valley between Brooklandville and Sherwood. Between the Mine Bank and Dulaney valleys is a great monoclinal fold of gneiss, having the marble of the Long Green valley at its centre and cut off by a fault along its southern edge. The strike of this area is north-northeast. On the opposite side of the map is seen a similar fold, whose trend is east-west, and at whose centre is the marble area of the "Caves" estate. Any faulting of this gneiss, which bounds the Green Spring valley on the north, against the marble is less apparent than in the last case.

The most complex relations of the dolomite are caused by the great boss of intrusive granite which forms the plateau east of Texas. From this the surrounding rocks dip away in all directions, while their strike follows its boundary, thus producing a quaquaversal structure. The gniess which adjoins this granite plateau on the north and north-west appears to be abruptly faulted against the marble between Texas and Cockeysville.

These broad outlines of structure it is difficult to explain, but they will serve to show how complex the stratigraphy of the dolomite is.

Relations of the Dolomite to Topography.—There are few places where the dependence of topography upon the nature of the underlying rock can better be seen than in the contrast between the flat narrow dolomite valleys of Baltimore county, and the abrupt ridges of gneiss and quartz-schist which bound them. The ready solubility of the marble has caused it to rapidly sink down, leaving behind its small insoluble portion in the form of a bright red residual clay, which composes its overlying soil. Thus we find a valley in every limestone area, even

when no important stream flows through it. Standing on some high projecting point of gneiss, we can follow for miles the boundaries of the limestone in the contours of the sharply defined valleys, as distinctly as though we had a geological map spread out before us.

The failure of the larger streams to follow these well marked valleys is a striking feature of the Baltimore County topography. The suddenness with which the Gunpowder river or Western run, for instance, turn aside from a limestone valley to cut a narrow gorge through a gneiss ridge indicates that the present drainage system originated under different conditions of surface than that which now obtains.

Uses.—The Baltimore county marble is extensively quarried either for burning, or for use as a flux, or as a building stone.

The first use was formerly much more extensive than it is at present. Nearly every farmer on the limestone areas quarried and burnt his own lime and supplied his less fortunate neighbors. Now, however, it is more economical to import the necessary quick-lime from the Frederick valley. The dolomite is still burnt at Texas, but most of the other kilns throughout the Baltimore neighborhood have fallen into disuse.

Some of the largest quarries near Texas are now worked for flux used by blast furnaces—those of the Maryland Steel Company being the largest consumers.

The most important application of the dolomite is, however, to the construction of buildings. The quarries of Hugh Sisson & Sons, near Cockeysville, are well

known. The following account of their present status has been kindly furnished by the owners:

The Beaver Dam marble from Cockeysville, Baltimore County, Md., is a dolomitic limestone of superior quality and of a uniformly white color.

The U. S. Government tests, made by Lieut. Col. Q. A. Gilmore, show that for durability and strength it is unequaled, its compressive strength being 22,416 lbs. to the square inch, which is greater than of any other marble, limestone, or granite, while its absorption of water is so slight as to be practically nothing. It is nearly free from discoloring agents, and this fact, taken with its non-absorbing qualities, establish its durability and permanency of color.

The quarries have been worked for over 60 years, and in that time the marble has been used in the construction of many of the largest and most important buildings in the country, such as the Capitol at Washington, where 108 large columns, each 26 feet in length, were furnished; U. S. Post Office and Washington Monument at Washington; Peabody Institute, Maryland Club, Rialto building, etc., in Baltimore; the Drexel and Penn Mutual Insurance buildings in Philadelphia; the spires of St. Patrick's cathedral in New York, etc.; together with a score of handsome churches and hundreds of beautiful residences in the different cities.

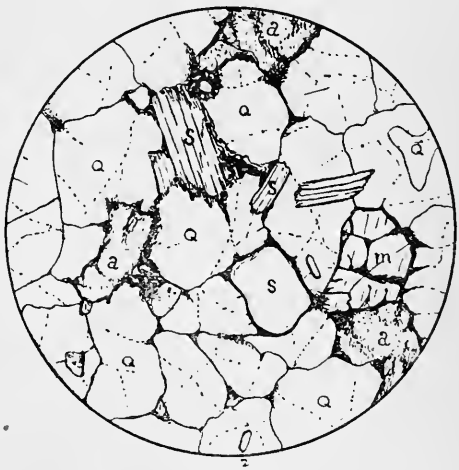
The annual out-put of the quarries is about 27,000 tons, at a cost of about $125,000.

The Company have a large plant of the most improved machinery, including saw mills, channelling machines, steam drills, diamond drills, locomotives, hoisting engines, derricks, etc., etc.

The Quartz-Schist.

Petrographical Character and Structure.—The least important of the rocks of probably sedimentary origin in the Baltimore region is a peculiar schist composed mostly of quartz and divided into beds of varying thickness by parallel layers of muscovite. The adjoining figure shows

the microscopical appearance of this rock. Its quartz grains are of different sizes, but are so completely recrystallized that they form an interlocking mosaic. Beside the flakes of muscovite, the only other constituents are iron stains and occasional crystals of tourmaline, microcline and zircon. Sharply defined areas showing a minute spherulitic polarization are also common. They are identical with those occurring in the Saxon "*greisen*," and probably represent altered feldspar. The rock shows the effect of pressure in the undulatory extinction of its quartz grains. The cleavage planes of the quartz-schist are due to thin layers of muscovite in good-sized scales, with their basal planes all parallel to the foliation. Its most characteristic feature is imparted to this rock by long crystals of black tourmaline which have been developed in these muscovite layers. These crystals are invariably broken and their fragments separated along one line, showing that the rock was compressed in one direction and elongated or stretched in another at right angles to it. These tourmaline crystals closely resemble the broken and pulled out belemnites

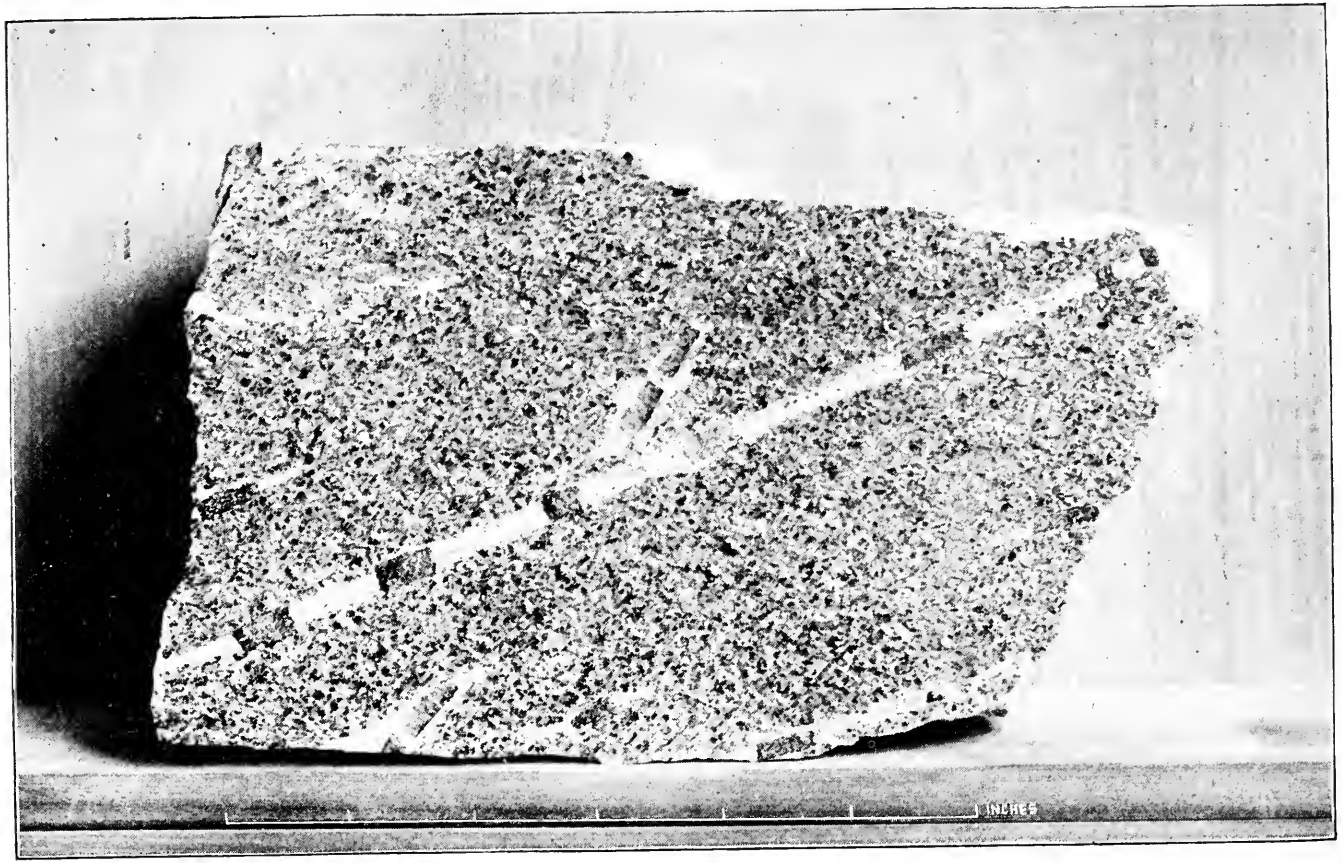


Microscopical section of the Quartz-Schist. Magnified 25 diameters. *Q.* quartz; *m.* microcline; *s.* muscovite; *z.* zircon; *a.* aggregates due to alteration of a feldspar (?). Iron hydroxide stains.

which Heim has described and figured from certain Swiss rocks. The appearance of a cleavage surface of the quartz-schist, covered with muscovite and such elongated tourmaline crystals, is shown on the accompanying plate.

The quartz-schist never attains any great thickness. Its normal position is between the gneiss and the marble and *below* the latter. Its most characteristic occurrence is in what is known as Setter's ridge which extends as a prominent topographical feature along the southern edge of the Green Spring and Mine Bank limestone valleys all the way from Green Spring Junction to a point beyond Summerfield, except where it is interrupted by the great faulted marble block north of Lake Roland. Although, as above stated, its normal position is between the marble and gneiss, it rarely occurs except on *one* side of a limestone valley—a fact which indicates that the monoclinal succession of strata has been produced by faulting. In some cases the quartz-schist appears to be altogether absent between the gneiss and marble, while in others it attains a considerable development within the gneiss where no marble at all is visible. The latter is true of the quartz-schist band extending eastward and westward from Pikesville, and of that which stretches in a southwest direction from Mt. Washington to Montebello. The petrographical character of this rock with its elongated black tourmalines, is so marked and so constant that its recognition is easy, and the narrow bands in which it occurs are useful guides in tracing the main lines of structure in the gneisses.

Whatever the origin of the quartz-schist may have been, it is closely allied to the gneiss, into which it



QUARTZ-SCHIST FROM SETTER'S RIDGE (SHOEMAKER'S QUARRY), SHOWING THE REMARKABLY STRETCHED TOURMALINE CRYSTALS.

grades by imperceptible transitions. It is, however, always sharply defined against the limestone. It is not improbable that this peculiar rock represents a facies of the gneiss, produced by some dynamic agency, for it always shows the effects of intense mechanical action and motion. Moreover the abundance of tourmaline points to the agency of fumaroles which are always important factors in the recrystallization of deeply buried rocks. It has occurred to the writer to compare this rock in its relation to the gneiss with the Saxon "*greisen*" in its well-known relation to the granites. (See Rosenbusch: *Die massigen Gesteine*, p. 44.)

Uses.—The readiness with which the quartz-schist cleaves into broad slabs well fits it for flagging. It is quarried at a number of points in the Green Spring valley, but is best exposed in the Shoemaker quarry, about half a mile west of Stevenson station. From here it is transported for considerable distances, and may often be seen in foundations and bridge abutments.

A different variety of the quartz-schist from that above described, occurs on the eastern edge of the Texas marble area, between it and the plateau of eruptive granite. The rock is of a pale grey color and compact fine grain. It is quarried directly below the county almshouse. North of this it is mostly composed of hollow spherulitic aggregates of radiating quartz crystals. A similar orbicular quartzite occurs as a vein in the dolomite near Brooklandville. This structure is strongly indicative of an origin through fumarole agency.

ERUPTIVE ROCKS.

The three types of eruptive rocks have all broken through and have more or less modified the gneisses, and are hence younger than these rocks. The intense dynamic action, which has produced such complete recrystallization in the banded complex, has likewise greatly metamorphosed the eruptive rocks, and yet not enough to have obliterated their original character. Each type exhibits several chemical or structural facies dependent on the original differentiation of the magma or upon conditions of solidification, and to these must be added other varieties due to subsequent metamorphism. These eruptive rocks will be considered in order of their age, beginning with the oldest. Much interesting detail may be omitted from these descriptions because full accounts of them have either been, or are soon to be, published elsewhere.

The Gabbro.[1]

Petrographical Character.—For detailed information regarding this rock and the products of its metamorphism, reference must be made to the text and plates of the memoir cited above. It is a rather fine-grained granular aggregate of hypersthene, diallage, plagioclase (bytownite), and magnetite, with varying amounts of apatite and brown compact hornblende. It is usually, when unaltered, massive, dark in color, and heavy, with a de-

[1] See, "The Gabbros and associated Hornblende Rocks occurring near Baltimore, Md.," by George H. Williams. *Bulletin of the U. S. Geological Survey, No. 28*, Washington, 1886.

cidedly trappean aspect. There is considerable variation in the grain of this rock, but most of its original facies are chemical. Increase of iron produces very dark and heavy varieties rich in magnetite, which, upon decomposing, produces a bright red soil; other varieties are of a pale buff color, but are rich in magnesia, thus forming transitions to the peridotites and pyroxenites; still rarer modifications are rich in alumina, producing highly feldspathic rocks; while others have an excess of silica in the form of blue quartz. In spite of these variations, however, the unmetamorphosed gabbro is remarkably constant in its character throughout its whole extent.

Metamorphism.—The dynamic effects so noticeable in the gneisses are also very apparent in the gabbro. The intense pressure has extensively changed the original pyroxene to secondary green hornblende (uralite) in a manner which has been so fully described in the above cited paper that it need not be repeated here. In some cases only the pyroxene has been changed and the resultant rock is as massive as the original gabbro, but has a greenish color. This is called *massive gabbro-diorite.* Where the action of the pressure has been more intense the entire rock has been recrystallized. In such cases the secondary hornblende usually has a parallel arrangement, producing a hornblende gneiss or schist. These rocks, when they can be shown to have originated by the metamorphism of the gabbro, are called *schistose gabbro-diorite.*

In the process of the dynamic metamorphism of the gabbro, several minerals beside the green hornblende are

produced, which are not found in the original rock. The most important of these are saussurite (zoisite), epidote, garnet, rutile and quartz.

The completeness of the metamorphism of the gabbro is found to depend largely on the size of the mass. The unaltered rock is found only in the largest areas and these are as a rule most changed around their edges. Small or thin masses of gabbro are completely changed to gabbro-diorite, and then usually of the schistose variety. Where the original rock is preserved, it and both varieties of the gabbro-diorite are so intimately mingled that no attempt has been made to distinguish them on the map.

Areal Distribution.—The main mass of gabbro which falls within the Baltimore sheet occurs west of the city. Its northern boundary runs nearly along Smith's avenue from Mt. Washington to Pikesville. A prolongation of this area extends eastward beneath the Potomac gravels, which hide its exact boundary, between Notre Dame and Guilford. Thence its eastern boundary is an irregular south-southwest line from Druid Hill Park to Relay. On the west and south this great gabbro area extends beyond the boundaries of our map.

To the gabbro in metamorphosed form must also be reckoned the extensive belt of dark hornblendic rocks, partly massive and partly schistose, which are exposed along the Belair road all the way to the Gunpowder river. These represent the southern end of the great gabbro belt of Harford county which crosses the Susquehanna river at Dublin. This belt tapers toward the south, running out in thin beds intercalated in the gneisses and, therefore, completely metamorphosed. The complete relation-

ship is concealed by the overlying gravels of the Potomac formation, but the rocks are well exposed by Stemmer's, Moor's and Herring's runs; also in Jones' Falls, south of Hoffman street, in Baltimore. In Gwynn's Falls; east of Wilkin's avenue, the hornblendic rocks only form a few narrow bands. The statistics of deep wells, sunk north and east of the city, indicate that these hornblendic rocks follow the north-west dip of gneiss to a considerable depth, like intrusive sheets.

A few unimportant layers of hornblendic rock, probably representing old gabbro dykes, but now completely metamorphosed, also occur at other localities as, for instance, on the Gunpowder river above Loch Raven, at Warren's Mills and at Cub Hill.

Effect upon the Gneiss.—Not only has the gabbro, in common with the other crystalline rocks of the Baltimore region, been the passive recipient of dynamic metamorphism, but it has itself been an active agent in modifying the surrounding gneisses, or the materials from which they were derived. The remarkable variation in the strike of the surrounding rocks which causes it to curve around the intrusive mass and remain approximately parallel to its boundary has already been noticed (p. 95).

There is every evidence that the gabbro originally solidified at a considerable depth below the surface, and that it has since been exposed by the removal of the overlying material. Under these conditions we might expect that so large a mass of eruptive matter would produce contact phenomena in the adjoining strata. This seems, to a certain extent, to have been the case. At least, there occurs around the large gabbro area, a very fine-grained

hornblende-gneiss which is capable of such an interpretation. This rock is conformable to the adjoining gneisses, and resembles them in being more acid than the normal gabbro. It has received a special designation upon the map. It is not always present at the edge of the gabbro, but a band of varying width extends from Relay to Woodberry, and it again occurs at the northern edge of the gabbro mass, between Pikesville and Mt. Washington. In the writer's opinion this rock represents the effect of the gabbro in producing contact metamorphism in the surrounding gneisses.

Alteration and Uses.—The gabbro offers great resistance to the ordinary processes of decomposition, and hence it is strewn abundantly all over the area which it occupies in the form of boulders. It is at the same time so hard, so heavy, and so jointed that it could not be quarried to any advantage as a building stone. The loose blocks are much used for constructing stone walls or foundations, and occasionally whole buildings are erected of them. This is the case with a church in Woodberry and with the new railway station at Arlington.

The Non-feldspathic Eruptives.[1]

Petrographical Character.—The second type of eruptive rocks which penetrate the gneiss complex near Baltimore is younger than the gabbro, but is genetically closely allied to it. These two types are connected by many

[1] See, "The Non-feldspathic Intrusive Rocks of Maryland and the Course of their Alteration," by George H. Williams, *American Geologist*, July, 1890.

intermediate varieties, and the more basic rocks, which break through the gabbros as well as through the gneiss, may be regarded as having resulted from a gabbro-magna which had become relatively poor in alumina, or in alumina and silica. The absence of alumina would prevent the formation of feldspar, and hence in the first case, crystalliation produced an aggregate of pyroxene (bronzite and diallage) called *pyroxenite* (websterite); while in the second case an aggregate of olivine and pyroxene with more or less magnetite was the result. This type is called *peridotite* (lherzolite). These rocks have already been so thoroughly described by the writer in another place that no repetition is necessary here.

Alteration.—The two non-feldspathic types of eruptive rocks, pyroxenite and peridotite, are peculiarly subject to alteration, which is not, however, decomposition. The details of this process are now being worked out. Briefly it is this: the pyroxene, when it occurs alone, tends to pass into secondary hornblende, and this in turn gives rise to talc. This is the origin of the extensive beds of steatite in eastern Maryland and Virginia. The talc is always mixed with more or less pale fibrous hornblende (tremolite) and chlorite.

When, as in the peridotite, olivine accompanies the pyroxene, especially if it is bronzite, the rock tends to form serpentine instead of talc. The serpentine also contained secondary hornblende formed from the diallage.

Distribution and uses.—Both types of non-feldspathic eruptives are very intimately associated. They do not, at least within the limits of our map, cover large areas,

but occur in small lenticular patches. Varieties intermediate between the two extremes are common, so that the two alteration products, steatite and serpentine, are even more intimately mingled than the rocks themselves. The attempt has been made to approximately distinguish the most prominent occurrences of the unaltered rocks on the map, but the alteration products are not separated from one another.

The best known and most extensive exposures of the basic eruptives within the limits of the Baltimore sheet are to be found in the well-known "Bare Hills," west of Lake Roland, and on the Falls turnpike. Just beyond the western border of the map there are other much more extensive areas.

Rock similar to the serpentines near Baltimore are extensively quarried for building stone in Chester County, Pa., but in Baltimore County they possess neither the requisite extent nor compactness for this purpose. The principal use made of them within our region is as road ballast. The serpentine of the Bare Hills contains considerable chromite and it was formerly mined for this material.

The steatite beds which have resulted from the alteration of the pyroxenite, although not quarried within the limits of our map, are quarried and manufactured near Marriottsville, on the adjoining sheet west.

The Granite.

Petrographical Character and Distribution.—The eruptive granites of central Maryland rival the gabbros in

extent and petrographical interest, while they greatly surpass them in economic importance.

These rocks are, as a rule, *granitites*, of medium grain and remarkably compact and homogeneous texture. They sometimes carry a considerable quantity of muscovite (Guilford), and are noticeable for the large and constant proportion of allanite which they contain. This mineral is surrounded by a parallel growth of the isomorphous epidote, as described by Dr. W. H. Hobbs.[1]

Variations in the structure of the granites are due to the development of porphyritic crystals, as at Ellicott City and along the road from Meredith's Bridge on the Gunpowder river to Cockeysville. Other structural facies are due to secondary features, like foliation, produced by dynamic agencies.

The occurrence of only small and comparatively unimportant areas of the granite within the limits of our map, as well as the fact that all these rocks are now being made the subject of an extended study, soon to be published by Mr. Chas. R. Keyes, renders a detailed description of them unnecessary in this place.

There are but two areas of undoubtedly eruptive granite within the limits of our map. The largest of these is the oval boss which occupies an area of about four square miles to the east of the Texas-Cockeysville marble belt. This granite is entirely surrounded by the marble, although it is adjoined by gneiss on its northwest and southeast sides, and by a thin band of quartzite

[1] On the paragenesis of allanite and epidote as rock-forming minerals. *Am. Jour. Science*, 3 ser., vol. 38, pp. 223–228. Sept., 1889.

on the west. This rock is nowhere very well exposed, but it appears to be a normal granitite of medium grain, which has suffered very much from dynamic action. A considerable area on its eastern side is developed as a granite-porphyry, which the intense pressure has converted into a coarse Augen-gneiss. (See map). This granite now forms a level-topped plateau, crossed from north to south by the Pot Spring road. The softer and more soluble rocks which surround it dip away from the granite in all directions, and, by their more rapid erosion, have left it completely encircled by a valley.

The second granite area is a narrow belt covering less than a square mile, which lies wholly within the gabbro, and extends from Highland Park to the Franklin road. This rock is quarried on the old Winan estate near Gwynn's Falls, and is represented in the 10th census collection of building stones in the National Museum. This granite has, like the other, been subjected to considerable dynamic metamorphism, and is in places quite gneissoid.

The Maryland granites are very much younger than the other eruptive types, and are not connected with them, as they are with each other, by intermediate varieties. They represent an entirely distinct epoch of eruptive activity. The evidence of their eruptive origin is most satisfactory and conclusive, although it must be sought without the boundaries of our particular map. They form intrusive bosses with diverging dykes and apophyses; they produce disturbance and crumpling in the rocks through which they break; they enclose fragments of the older rocks—gneiss, marble, quartz-schist, gabbro, and

pyroxenite; and finally they produce all the well-known phenomena of contact-metamorphism, both in these fragments and in the rocks which adjoin them.

The granites are extensively quarried for building and paving stones at Woodstock, Sykesville, Granite, Ellicott City, and Guilford, which, although not within the limits of the Baltimore sheet, represent the great granite masses just west of it.

The Pegmatite.

Petrographical Character and Distribution.—The gneisses of the Baltimore region are penetrated with a great abundance of dykes, veins and "eyes" of the coarse grained aggregate of quartz, feldspar and mica, known as *pegmatite.* The other crystalline rocks of the region, although to a less extent, contain the same material.

The Baltimore pegmatites are composed of a flesh-red or brownish microcline in large and brilliant cleavage plates, greenish-grey albite, gray quartz, and either a jet black, nearly uniaxial mica (lepidomelane), or a light colored, biaxial one (muscovite).[1] In some cases the mica is nearly or wholly absent, and the quartz and microcline have that peculiar intergrowth which is known as graphic granite. Good specimens of this occur at the Jones' Falls gneiss quarries and near Orange Grove, on the Patapsco river. In still other cases even the feldspar decreases in amount, until the pegmatite comes to resemble a quartz vein.

[1] The microcline and albite were analyzed by Mr. F. L. Nason; the black mica by F. W. Clarke and R. B. Riggs. See *Notes on the Minerals occurring in the Neighborhood of Baltimore*, 1887, p. 6, and *Bulletin U. S. Geological Survey, No.* 55, p. 14.

As is usual in coarse or pegmatitic granites, unusual minerals are often found in good sized and well developed crystals. Among those noticed in the Baltimore pegmatites may be mentioned black tourmaline, red garnet, apatite and sphene. A fragment once obtained by Mr. H. A. Brooks, at the Jones' Falls quarries in pegmatite, was determined by Prof. G. A. König as samarskite. Tyson also mentions beryl.

Veins or dykes of pegmatite are extraordinarily abundant in the gneiss. They are well displayed along Gwynn's Falls; on the Patapsco river; along Jones' Falls, particularly in the gneiss quarries; and along the Gunpowder. Both the muscovite and the lepidomelane-pegmatite occur in the gneiss, but the latter has been noticed only in this formation, while the former occurs in the gabbro, hornblende gneiss and limestone as well.

Origin.—The origin of pegmatite is a matter which has of late years been very much discussed. Two main views are sustained which are connected by a considerable number of intermediate hypotheses.[1] One school, following Charpentier, Naumann and Brögger, maintain that pegmatite is eruptive; while the other holds with Saussure, Hunt and Herm. Credner, that it is the product of lateral seggregation by aqueous agencies.

Within the Baltimore region the pegmatite appears to have been produced in both these ways. At least we seem compelled by direct evidence to assume that certain occurrences of it are true eruptive dykes, genetically

[1] For an admirable summary of all the various theories regarding the origin of pegmatite, see W. C. Brögger in the *Zeitschrift für Krystallographie*, vol. 16, pp. 215–226, 1890.

related to the normal eruptive granites already described. For other occurrences an aqueous origin, by seggregation, appears more probable, although the proof is not as good as in the former cases. The evidence in favor of each of these origins may be stated in brief.

Proofs of Eruptive Origin.[1] 1. They have the structure and composition of true eruptive granites.

2. They occur in true branching dykes, cutting across the strike of the including rocks at all angles.

3. They are sometimes finer grained at the edges of the dykes than in the center (Orange Grove).

4. They include large and small fragments of the adjoining rock which are greatly displaced, so that their foliation stands at all angles within the dyke.

5. The amount of pegmatite at any locality stands in direct connection with its proximity to some large area of eruptive granite. This is admirably seen along the Patapsco river between Ilchester and Relay; also in the neighborhood of Ellicott City. It is strongly suggestive that the source of the pegmatite was in some way connected with the granite magma.

6. The extent and nature of the pegmatite is wholly *independent* of the surrounding rock. The same muscovite pegmatite occurs in the basic gabbro near Mt. Hope and between Gwynn's Falls and the Liberty Road; in the gneiss along Jones' Falls and the Gunpowder river, and in the dolomitic marble between Notch Cliff and Summerfield. The same dyke even extends from one of these

[1] For a detailed description of two occurrences of eruptive pegmatite near Baltimore, see George H. Williams: *Johns Hopkins University Circulars*, vol. 4, p. 65, No. 38, March, 1885.

formations into another without the least change in its character.

The strongest proof advanced in favor of the origin of pegmatite by seggregation is that the rock either ceases altogether, or changes its character on passing from one formation to another of different composition. Whatever may be the facts in other regions, this is certainly *not* true of most of the pegmatites occurring near Baltimore, and the opposite is considered to be good evidence of their exotic and eruptive origin.

Proofs of Seggregation. With regard to certain other occurrences of pegmatite in the gneisses near Baltimore, the evidence seems to be rather in favor of an origin by seggregation or some aqueous means. While the rocks themselves may be petrographically quite like those mentioned above, certain things about their mode of occurrence render a different origin probable. These points may be summarized as follows:

1. They have a more or less pronounced zonal structure like ore veins.

2. They occur in lenticular "eyes" in the gneiss, which are enclosed on all sides, and have no visible connection with any foreign source of supply.

3. They are not sharply defined against the surrounding gneiss, as are the above described dykes, but they merge gradually into this rock.

4. They are genetically related to the abundant quartz-veins, and may pass into such veins by a gradual diminution of their micaceous and feldspathic constituents. Some of these veins are typical pegmatites in one part and typical vein-quartz in another.

Pegmatite of this latter class occurs only in the gneiss, to which it has the closest chemical similarity and from which its material may well have been derived.

In view of these facts it seems necessary to assume a two-fold origin for the Baltimore pegmatites, even though hand specimens of the two varieties might not be distinguishable.

Quartz-veins.—The quartz-veins above alluded to are genetically related to the pegmatites of the second class and deserve mention on account of their great abundance. In many localities where the rock is superficially much decayed the ground is covered with boulders of so-called "flint." It is usually supposed by the farmers that this substance must altogether compose the underlying rock, but at a favorable exposure this can readily be seen not to be the case. These boulders merely represent the indestructible substance of the quartz-veins, which has been left in the soil formed by the decomposition of the enclosing gneiss.

The great abundance of the vein-quartz all through the metamorphic portion of Maryland, may be taken as a good indication of the amount of faulting and dislocation to which it has been subjected. Vein-quartz is the substance with which Nature heals the wounds in the earth's crust, and its occurrence marks the scars caused by ancient fractures.

In some places, just outside our sheet, the vein-quartz becomes a substance of economic importance. North of Marriottsville and at Castleton, Harford County, it is quarried and ground to be used in the manufacture of porcelain, for which purpose it is shipped to Baltimore and to Trenton, N. J., in large quantity.

ORE DEPOSITS.[1]

Aside from the marble, gneiss, granite, steatite and quartz quarried for building and other purposes, the crystalline rocks near Baltimore yield little of economic value.

What there is in the way of ore deposits that have been worked within the limits of our map, possess an historic rather than a present interest. They may be grouped under the three heads of iron, chrome and copper ores.

Iron ores.—These are iron hydroxides or bog iron ores, commonly known as "brown hematites," and occur in the crystalline limestones near their contact with the gneiss. In the northern portion of the sheet there are many extensive beds of this ore which were formerly worked and the product sent to the Ashland furnace. The ore is very easily reduced and valued for mixing with others of a more refractory nature. The grade is, however, low, and none of the ore-beds are at present being worked, nor is the Ashland furnace in blast. The principal openings are north of Towson, near Timoneum and Lutherville, on the north side of the Green Spring valley near its upper end, on the small limestone area known as "The Caves," and at Oregon.[2]

[1] For list of all mineral substances of industrial importance occurring within the State of Maryland, by Professor John C. Smock, see *Mineral Resources of the U. S.*, vol. I, 1883, pp. 690–693.

[2] For descriptions and analyses of these deposits, see vol. 15, Reports of the 10th Census, pp. 254–257, 1886.

The occurrence and origin of these ore beds is the same as those of Pennsylvania, where they have been more extensively studied. Theories of their origin have been advanced by J. D. Dana,[1] Prime, Frazer[2] and Ewing.[3] Dana and Ewing consider the ores to have been principally derived from the oxidation of ferrous or ferriferous carbonates originally in the limestones. Benton makes similar observations on the limonites of Wythe Co., Va.[4] Frazer considers the ores to have been formed from the extensive oxidation of pyrite which once existed in the underlying slates. Prime states that they are due sometimes to the leeching of the hydromica schists, and sometimes of the limestone, and says that it is easy to distinguish the two cases.

Other important, but much younger, iron ores occur near Baltimore in the form of carbonate nodules in the clays of the Potomac (Jurassic) formation.[5]

Chrome Ore.—This was formerly worked to some extent by the Tysons in the serpentine of the Bare Hills.[6] The pits at this locality have long since been abandoned, but they still furnish some interesting mineral specimens, including chromite, rhodochrome, talc, magnesite and opal.

[1] On the making of limonite ore beds, *American Journal of Science*, 3d series, vol. 28, p. 398, Nov., 1884.

[2] Reports of the Second Geological Survey of Pennsylvania, vol. C, p. 136.

[3] Ditto, vol. T-4, pp. 406–410.

[4] See vol. 15, Reports of 10th Census, p. 275, 1886.

[5] *Ibid.*, pp. 245–254; also, page 135 of this book.

[6] See page 60 of this book.

Copper Ore.—There is but one vein of copper ore (chalcopyrite) within the boundaries of our map that has ever been worked. This is in the hornblende gneiss on the south side of the Bare Hills and about one mile west of Mt. Washington. An oblique shaft has been sunk along the 45° dip of the vein for eight hundred feet. The product has never been important, but the mine has been worked sporadically since 1845. It produces considerable that is of mineralogical interest beside its copper ore. The gangue of the vein is a peculiar variety of amphibole in broad brown blades which has the chemical composition of anthophyllite, but whose optical behavior is monoclinic. It is the mineral amphible-anthophyllite of Des Cloizeaux.[1] Other minerals found at this mine are hornblende, chlorite, pyrite, bornite, and sharply crystallized octahedral magnetite.

Another vein of copper ore is deserving of mention in this connection on account both of its scientific and economic interest, in spite of the fact that it lies beyond the western boundary of our map. This vein can be traced with great distinctness from a point south of the Patapsco river at Sykesville to Finksburg in Carroll County, and with less distinctness to Blue Mount, south of Whitehall on the Northern Central railroad, and to Cooptown in Harford County. On it are situated the old Springfield mine at Sykesville, the Mineral Hill mine, the Patapsco mine near Finksburg. All of these have been valuable in their day, that at Sykesville being the most so. This

[1] For description of this mineral and analysis by C. S. Palmer, see *American Naturalist*, Sept., 1885; and *Neues Jahrbuch für Mineralogie, etc.*, 1885, II, p. 175.

locality was first opened on the old Patterson estate by Jas. W. Tyson in 1849 as an iron mine (magnetite), the ore being reduced in his Elba furnace, just below Sykesville. With increasing depth, however, the ore changed from magnetite to chalcopyrite, and the mine was worked with profit for copper until 1868. The product was in 1858, 475 tons; in 1859, 684 tons; in 1860, 738 tons; and 1861, 1,728 tons.

At Mineral Hill, half way between Sykesville and Finksburg, an opening was made for copper as far back as revolutionary times. This locality was opened again by Mr. Tyson in 1849, and has been worked at intervals until quite recently. In 1888 the main shaft followed the vein with a 50° dip for 370 feet below the surface. There was an adit from Morgan's Run for 190 feet, and levels at 60, 120 and 180 feet. The ore produced is chalcopyrite, bornite and chalcocite, together with some magnetite.

The Patapsco Mine at Finksburg was first opened by Mr. Tyson about the same time as the others. It is like the others in character. It was abandoned at the breaking out of the war, but was reopened for magnetite by a Philadelphia company in 1880. These workings have been totally abandoned for ten years past.

These copper deposits are all on a true fissure vein, whose existence can be traced continuously across Carroll County. It represents a line of considerable dislocation as may be seen from the greatly contorted and faulted character of the material brought up from the workings. The nature of the vein may best be studied at Mineral Hill. The gangue is largely talc (steatite), often con-

taining rhombs of siderite. With this are associated as gangue minerals actinolite, epidote and quartz. There is also some quartzose slate gangue. The nature of the deposit as a true fissure vein seems beyond a doubt, and it is not impossible that more extensive explorations might reveal even larger masses of ore than those heretofore brought to light.

These three copper mines, aside from their economic importance, possess a peculiar scientific interest for having produced some unique minerals. Carrollite (or cuban with cobalt in place of the iron) is known only from the Springfield and Patapsco mines,[1] while remingtonite, a rose-colored hydrous cobalt carbonate, occurs at the latter as its sole locality. Native gold in thin flakes occurs on foliated magnetite at Mineral Hill, and pyrite, bornite, siegenite and malachite may be mentioned as occurring at all.

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[1] See, Smith and Brush: Reëxamination of some American minerals, *American Journal of Science*, 2d series, vol. 16, 1853.

THE GEOLOGY OF BALTIMORE AND ITS VICINITY.

PART II.

PHYSIOGRAPHY OF THE REGION AND GEOLOGY OF THE SEDIMENTARY ROCKS.

By N. H. Darton,
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PHYSIOGRAPHY.

The city of Baltimore is situated on the border zone between two great physiographic provinces—the Piedmont plateau and the Coastal plain. The Piedmont plateau comprises the wide belt of contorted crystalline rocks extending to the Appalachians; the Coastal plain is the region of gently east dipping Mesozoic to Pleistocene sediments which borders the Atlantic Ocean from New York to Florida.

While both provinces are included in a great plain or series of plains which extend from the Appalachians to the Ocean with gradually decreasing elevation, most of their surface features are very dissimilar. In the Piedmont plateau the plains represent an old base level carved

in the crystalline rocks and were originally quite level, but as there is now no protecting mantle and the crystalline surface is deeply softened by decay, the old plains have given place to an undulate contour for much of the area. The streams having to cut in hard rocks, have excavated narrow channels with steep, but relatively uniform declivities. In the Coastal plain the drainage has cut widely and deeply into the soft sediments, and the streams of the Piedmont plateau flow eastward to the ocean through wide basins, which now hold tidal estuaries in the case of the larger rivers. These basins are terraced more or less widely with Pleistocene river deposits and although these lateral terraces extend as narrow shelves up some of the Piedmont gorges for a few miles, they are characteristic of the Coastal plain. Southward from the latitude of Washington, the Coastal plain is characterized by broad areas of a high, very flat, gravel-capped plain, but this plain is widely eroded northward, and finally represented only by a few scattered fragments on the highest divides.

A single general drainage system is common to the Piedmont plateau and Coastal plain, although in the western part of the former, the main lines of drainage were indented and more or less extensively developed before the Coastal plain had finally emerged. The great streams flow through the Appalachian ridges and across the Piedmont and Coastal plain regions to the sea without relation to rock texture, but on the Coastal plain between the Hudson and Rappahannock rivers they are deflected southward. These deflections owe their origin to irregularities in the submarine surface, which on the emergence

of the region in late Tertiary, gave direction to the eastward extension of the streams.

The border zone, in which the Piedmont plateau and the Coastal plain merge, is a region presenting certain noteworthy physiographic characteristics. In the divides the level surface of the high plains is continuous across the feathered edges of the Coastal plain deposits, and the termination of these deposits is not marked by conspicuous topographic features. In the drainage ways the streams flow out of the narrow rock-bound valleys of the Piedmont region into wide basins in the soft Coastal plain sediments, and river terraces become conspicuous. With the disappearance of the crystalline rocks, falls and rapids in most cases give place of quiet waters. In the larger streams, tide water extend to the edge of the crystallines or a short way beyond, and this juxtaposition of the head of navigation and water power, at what is termed the "fall line," was chiefly instrumental in locating along the border zone, certain of the early settlements which eventually became the cities of Trenton, Philadelphia, Baltimore, Washington, Fredericksburg, Richmond, Petersburg and some other places.

Baltimore is on the Patapsco river near the head of tide, but the city is built in greater part on the slopes adjoining a side stream known as Jones' Falls. The region is one in which the Coastal plain deposits have been deeply and widely eroded and consequently, presents great diversity in its topography. The city occupies sloping Pleistocene terraces of the Patapsco depression, extending northward from the river to an altitude of 200 feet. To the south and east these terraces have been deeply eroded, giving

place to wide areas of rounded surface, but fragments of the terraces are prominent on some of the higher summits, and they also constitute low plains adjoining the rivers.

This region is sharply demarked to the west and northwest by the steep slopes of the shore line of the open sea of Pleistocene times, which passes just north of Baltimore and extends for many miles to the northwest and southwest with great distinctness.

To the north and west of this shore line the country rises gradually, and its surface is broken by rounded ridges of irregular outline, and by deep, steep-sided drainage ways. Farther back in the higher lands, some of its outlying remnants are met with, and then the edge of the old base-level plain, which, although deeply intersected by drainage, is still represented by wide areas of original surface but slightly rounded in contour. In this part of the region there are certain secondary features which most clearly illustrate the relations of rock texture to topographic form. The more elevated areas are mainly underlain by gabbro, granite and gneiss, and enclose a sharply demarked depression of considerable extent excavated in the softer marbles. This depression is very irregular in outline, has a typical rolling surface, and its widest area, instead of being a valley, is a general divide for the drainage of a large district. The hard quartz-schist of the Towson region give rise to a prominent ridge rising very abruptly as part of the rim of the marble depression.

Another prominent feature is the deep gorge of the Gunpowder river which traverses the region, and although this gorge does not differ materially from other Piedmont stream cuts, it has some interesting relations. It flows

from the north into a corner of the marble depression, but instead of flowing around the ends of the high ridges of granité and gneiss, as might be expected, it cuts across them without material deflection. As in the case of the other larger drainage ways of the Piedmont plateau and the Coastal plain, the course of this river was determined when the region was evenly mantled by a level sheet of littoral deposits, which on emerging from the seas was indented by drainage systems in no way influenced in their course by the nature of the subterrain. Once established, the conditions have remained favorable in their courses, and the streams have finally cut their original channels down to their present depths.

GEOLOGY OF THE SEDIMENTARY ROCKS.

THE GENERAL STRUCTURE.

In the Baltimore region four of the great Coastal plain formations are represented, together with the physiographic products of several periods of erosion and topographic development. The general relations of these, and their nature, are indicated in the following table:

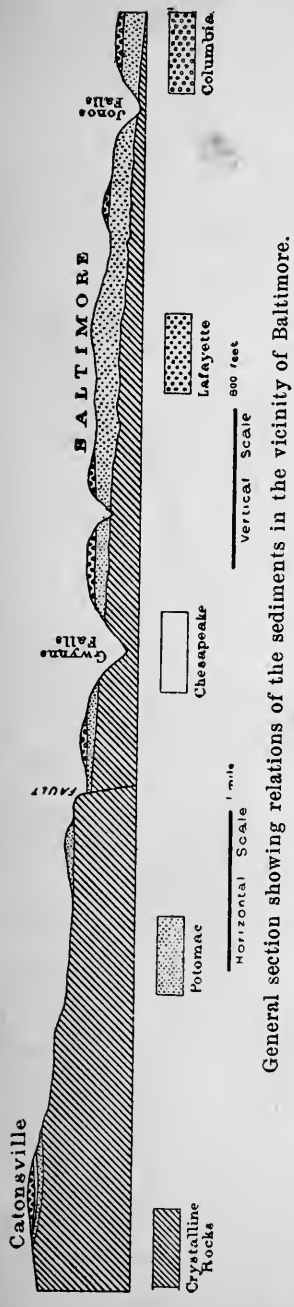
Formations, etc.	Characters.	Age.
	Alluvium (mainly below tide water) and Marsh.	Recent.
	Erosion interval. Dissection of Columbia plains.	Later Pleistocene.
Columbia.	Gravels, sands and loams. Maximum thickness, 25 feet.	Early Pleistocene.
	Erosion interval. Development of outlines of present topography.	Pliocene (?).

Formations, etc.	Characters.	Age.
Lafayette.	Gravels and sands. Thickness, 10 to 20 feet.	Pliocene (?).
	Erosion interval. Cutting of the great base-level plains.	Miocene (?).
Chesapeake (?).	Soft buff sands. Thickness, 12 feet.	Miocene.
	Erosion interval. Following deposition of Pamunkey and Severn formations.	Eocene to Cretaceous.
Potomac.	Clays, sands and gravels. Thickness, 350 feet or more.	Early Cretaceous.
	Great erosion interval.	

Owing to subsidence, which is now in progress in the Coastal plain region, alluvium is deposited in tide water, and is a surface deposit only on freshet plains where its presence is transient. Marsh growth has kept pace with this subsidence at some localities, and there are several tide-marsh areas of small extent in the vicinity of Baltimore.

The Columbia formation lies on terraced plains cut on the surface of preceding formations. These plains originally covered the entire region to the east and south of Baltimore, and extended for many miles up the depressions in the higher lands to the north and west. Owing to tilting, the plane of deposition is now inclined from below tide-water level eastward, to an altitude of nearly 400 feet, northwestward.

The Lafayette formation originally capped the eastward extension of the great late Tertiary plain which is now represented in the Baltimore region by the high



General section showing relations of the sediments in the vicinity of Baltimore.

plateaus of crystalline rocks, and a few small outliers of the Lafayette formation. In these outliers the formation is inclined gently eastward and overlaps the edges of preceding formations.

The Chesapeake formation, which is so extensively developed to the southeastward, is represented on the Baltimore sheet by only a small thin wedge lying on an irregular surface on the Potomac formation.

The Pamunkey (Eocene) and Severn (Cretaceous) formations, which are conspicuous members of the Coastal plain series to the southeast, are wanting in the Baltimore region. How far they may have extended originally and their history westward are not known.

The Potomac formation is the most prominent representative of the Coastal plain series about Baltimore. It lies directly on a somewhat irregular floor of crystalline rocks, which slopes gradually to the southeastward from an altitude of 500 feet at Catonsville and Towson and is finally buried beneath several hundred feet of the formation. Owing to the gradual incli-

nation of the crystalline floor, the margin of the formation in its extension westward is broken into fingers and outliers separated by drainage depressions cut through the sediments more or less deeply into the crystallines. The Potomac formation also occurs in the marble depression about Lutherville which indicates that this depression was excavated in pre-Potomac times.

The Baltimore region is traversed by a dislocation or fault of small amount, the greater part of the course of which is apparently coincident with the shore lines of the open seas of the Columbia submergence. In the immediate vicinity of the city of Baltimore, its presence is not established, but to the southwest and northeast its effects are appreciable. It traverses the Potomac formation and its crystalline floor, with a downthrow on the eastern side, of from 20 to 80 feet but generally near 50 feet. This amount is not sufficient to materially disturb the areal continuity of the Potomac deposits, but it gives rise to a noticeable scarp in the crystalline rocks at most points. The movement was mainly post-Columbian and it may extend into recent times and now be in progress.

THE FORMATIONS.

The Columbia Formation.—The characters of the formation present considerable variety in the Baltimore region. Adjoining the shore line in the northern section of the city it consists of a gravel bed below, grading into a buff-brown loam above, having all the characteristics which it presents in the type exposures about Washington.[1]

[1] See McGee, *American Journal of Science*, 3d series, vol. 35, page 125–130, 1888. See second of the two geological maps.

There are fine exposures of this phase of the formation in the cuts for the Belt line railroad along Seventh street on Peabody Heights, where the gravels lie on Potomac clays, sands and gravels and overlaps on to the crystallines. Also in the western edge of the city; at Lafayette Station, and at several points along North avenue, particularly near Greenmount cemetery, in all of which it lies on Potomac sands.

In its extension eastward and southward on the higher levels, particularly on Patapsco Neck, interbedded and intermingled sands and gravels are most conspicuous, although the bipartite gravel and loam appears locally. In the low terrace fringing the southern portion of the city and extending eastward along the Patapsco Neck, gravels and gravelly sands predominate, which finally give place to grey sandy loams as the river is descended.

In the Gunpowder and Jones' Falls depressions there are many small remnants of gravels which are continuous with the shore deposits at the 200 foot level at the edge of the open sea of Columbia submergence but gradually increase in altitude as the valleys are ascended, finally to nearly 400 feet. The formation was originally a more or less continuous sheet in these depressions but now it remains only on narrow shelves in their narrower portions, and on the summits where the valleys are wide, as in the marble region. This portion of the formation consists of quartz and quartzite gravels, boulders and fragments. Its thickness varies from beds of appreciable thickness near Cockeysville quarries and between Bosley and Dulaney valley, to discontinuous sprinklings which constitute the greater number of areas.

A large part of the region submerged in Columbia times is now widely eroded and the deposits removed. On some of the summits and divides no traces of the formation are differentiable, although in these districts it is probable that the deposits were very scanty and consisted of a thin wash of local detritus, not conspicuously dissimilar from the subterrain.

The Lafayette Formation.—This prominent member of the Coastal plain series has been nearly all eroded from the Baltimore region. In the high ridges east of Towson there are remnants capping the Potomac sands and gravels, and about Catonsville there is an outlier of considerable extent. The materials consist of quartzite and quartz pebbles, mainly of moderate size, imbedded in buff and red sandy loams. The pebbles are usually stained red superficially—a nearly general characteristic of the formation. The clearest exposures are in the railroad cuts between Catonsville and State Asylum, and in the ridge just east of Cowpen Station and a mile due east.

The Chesapeake Formation.—The small, thin outlier, probably of this formation, on the Catonsville ridge, consists of fine, soft, buff sands, which have a maximum thickness of only twelve feet. Its best exposures are in a fine section along the railroad, about a half mile south of Catonsville, where it is seen to be intercalated between the Potomac sandy clays below and the Lafayette gravels above, lying nearly horizontal. It is also to be seen in a pit in the village where it is worked to a small extent for moulding sand. Its precise limits have not been determined.

The Potomac Formation.—This formation consists of a great series of sands and clays lying directly on the crystalline rocks, and occupying the surface for a considerable width in the Baltimore region. Southeastward it thickens gradually, finally to over 300 feet, and in fifteen miles, dips gently below the Severn sands, which are the attenuated southern extension of the New Jersey greensand series. Northwestward it has been deeply eroded, and finally feathers out in an irregular belt of ridges and outliers which attain a maximum altitude of 500 feet at Catonsville and Towson. In this region the greater mass of the formation consists mainly of clays, usually of bright tints of buff, grey, pink or brown, but they are often white, locally, and not infrequently black. Scattered irregularly through this portion of the formation, intercalated beds of sharp, white sands are often met with, and in some cases they attain considerable thickness. These sands generally are sharply demarked from the clays below, indicating sudden change in the conditions of sedimentation and often local erosion, but laterally and upward they grade into the clays. In many cases, also, the sands and clays are streaked together and intermingled. The clays also contain occasional beds of lignite and much scattered lignitic material.

It is in this clay series that the well known siderite iron ores of eastern Maryland occur, which have been worked to a moderate extent for over a century in a belt extending about twenty miles north and south from Baltimore. The siderites are concretionary in nature, and are distributed irregularly through certain portions of the clays in nodules and streakings. The most exten-

sive mine now in operation is near Hanover Station, about thirteen miles south of Baltimore, but there are also instructive workings on the east side of Federal Hill, in the southern part of the city.

Towards the western margin and shore of the Potomac formation, sandy beds predominate, although quite pure clays lie directly on the crystalline rocks at some localities. The marginal sands are often quite pure for a considerable thickness, or only slightly streaked with clay or ferruginous layers, and they are extensively worked for building sands in Baltimore and vicinity. The finest exposures are along the western edge of the city proper, adjoining the eastern fork of Gwynn's run, but there are also good exposures along North avenue, opposite the northeastern corner of Greenmount cemetery.

In the ridges and outliers north of Baltimore, the shore line deposits consist mainly of gravels and light colored gravelly arkosic sands. These gravels lie on the crystalline rocks, and at some localities attain a thickness of twenty-five feet. They grade into sands and clays above, and laterally, and their distribution is very irregular. The finest exposures are out Charles Street avenue and near Govanstown, where the gravels have been quarried to some extent for road making; a use for which they are well adapted.

In the marble depression the formation occurs on the summits about Lutherville, extending from altitudes of 390 to 440 feet above tide. In this district the formation consists of sands, gravels and clays, having every characteristic of the Potomac deposits farther south. The Potomac formation is the only fossiliferous member of the Coastal plain series about Baltimore. Its clays

and sands contain plant remains in considerable variety. Federal Hill is the best known locality near Baltimore.

MESOZOIC TO PLEISTOCENE HISTORY.

The geologic history of the Baltimore region is not as yet fully deciphered, but recent studies have thrown considerable light on the conditions during parts of the time. It would increase the length of these notes too greatly to give all the evidence bearing on the history of the region and the following account is limited in the main to a resumé of the principal episodes.

The earliest condition of which the record is clear is the great plain on which the Potomac formation was deposited. This plain was relatively level, but in the marble area north of Towson its continuity was locally interrupted by an irregular depression. The plain extended many miles westward, apparently entirely across the present Piedmont plateau.

The planing was followed by an early Cretaceous submergence attended by the deposition of the littoral sediments of the Potomac formation which finally covered the plain, probably to its western edge, and with a gradual increase of thickness eastward.

Potomac deposition gave place to uplift and erosion, but to an amount not definitely known. This era was followed by a series of periods of submergence and deposition separated by intervals of emergence and planing, during which the Severn (Cretaceous), Pamunkey (Eocene) and Chesapeake (Miocene) formations were deposited in successive sheets over the Coastal plain region. About

Baltimore this series is now represented only by a small, deeply eroded remnant of the Chesapeake formation, and no data is available concerning the extent, relations or local history of the formations in this region. During this Cretaceous to Miocene interval, the Piedmont region westward was gradually tilted upward and its surface more or less extensively eroded.

The next era was a late Tertiary emergence which resulted in wide-spread planing. The Piedmont plateau region was cleared of Potomac remnants westward, the old pre-Potomac plain was recut so as to mask the details of prexistant topographic forms, if not entirely to efface them, and the Coastal plain region was deeply planed. The result was an erosion-plain of vast extent. In the submergence following this era, the gravels and sands of the Lafayette formation were deposited as a thick mantle spread over the entire eastern part of the plain, from an irregular shore line, which, in the Baltimore region, was not far beyond the eroded edges of the preceding Coastal plain formations. On the crystalline plains between Pikesville and Baltimore no deposition appears to have taken place, unless, perhaps, a slight local rearrangement of decomposed crystalline detritus, and the outliers on the high ridges at Catonsville and east of Towson appear to be at the shore line.

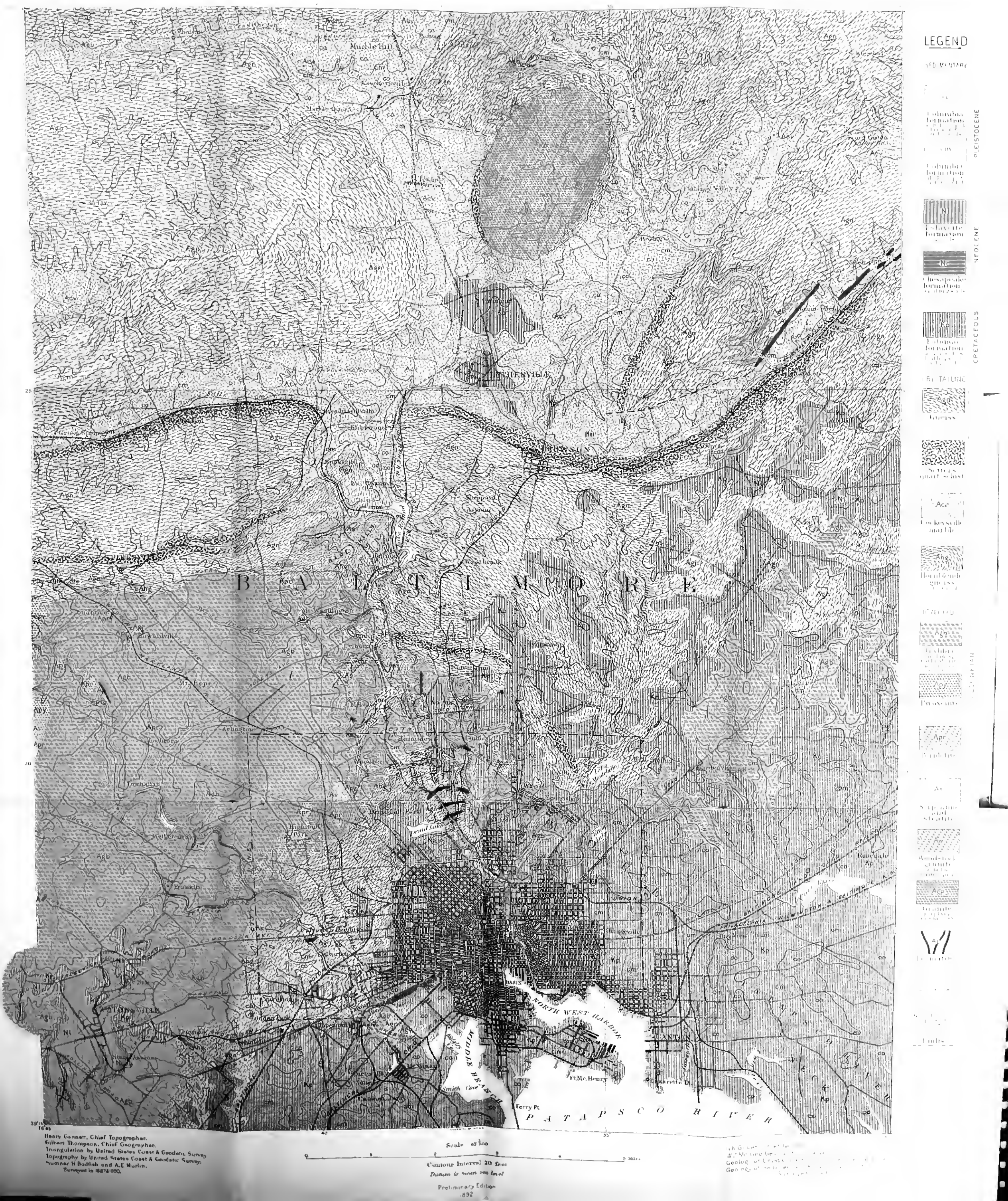
Lafayette deposition was succeeded by emergence attended by the development of the present drainage systems in the Lafayette covered regions and the revival of drainage in the replaned belt on the Piedmont plateau. The drainage systems rapidly removed the greater part of the Lafayette formation in the Baltimore region, and

deeply eroded the underlying formations and crystalline rocks, giving rise to the general features of the present topography, above the line of Columbia submergence.

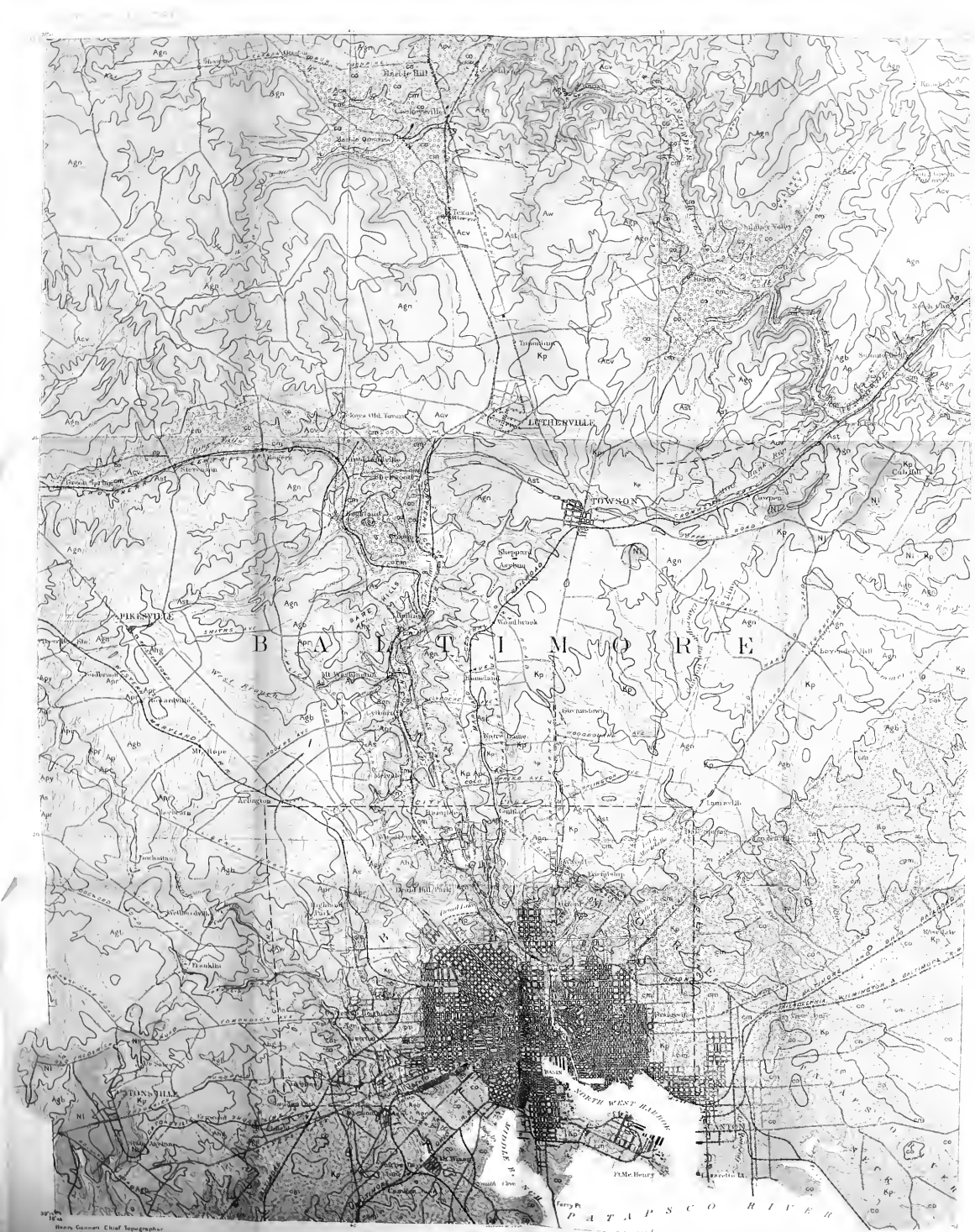
This submergence was the next event, and its deposits were laid in a sheet of variable thickness over the entire region about Baltimore to the south and east, and on the floor of the valleys of the principal drainage ways to the north and west.

Columbia deposition gave place to emergence, and the erosion of the sub-Columbia surface to its present form. This emergence was greater in amount toward the northwest, for it has tilted the Columbia formation several hundred feet out of its original plane.

The next era is the present. It is one of gradual submergence eastward, which has resulted in the invasion of tide water up the drainage ways for some distance. It is no doubt, connected with the dislocation and possibly, also, in part, with the tilting of the Columbia deposits.



LEGEND
Columbia formation
PLEISTOCENE
Lafayette formation
NEOCENE
Chesapeake formation
Potomac formation
CRETACEOUS
Gneiss
Setters quartz schist
Cockeysville marble
Hornblende gneiss
Gabbro
Pyroxenite
Peridotite
Serpentine and steatite
Granite
Faults
B A L T I M O R E
NORTH WEST HARBOR
MIDDLE BRANCH
PATAPSCO RIVER
CANTON
Ft.McHenry
Ferry Pt
Smith Cove
Catonsville
Arlington
Mt. Hope
Henry Gannett, Chief Topographer.
Gilbert Thompson, Chief Geographer.
Triangulation by United States Coast & Geodetic Survey
Topography by United States Coast & Geodetic Survey,
Sumner H Bodfish and A.E Murlin.
Surveyed in 1887-1890.
Contour Interval 20 feet
Datum is mean sea level
Preliminary Edition
1892



LEGEND

PLEISTOCENE

NEOGENE

CRETACEOUS

ALGONKIAN

Henry Gannett Chief Topographer
Willard Thompson, Chief Geographer
Triangulation by United States Coast & Geodetic Survey
Topography by United States Coast & Geodetic Survey
Surveyed in 1892 & 1893
Surveyed in 1892 & 1893

Scale of Miles

Contour Interval 20 feet

Datum is mean sea level

Preliminary Edition
1897